

Members of the S. A. E. party cruising through the Thirty Thousand Islands of Georgian Bay

S. A. E. Cruise Big Success

Valuable Discussion on Sixteen Papers Covers Broad Phases of Industry—Six Standards Reports Passed

By J. Edward Schipper

DETROIT, MICH., JUNE 17—Today closed the 4-day convention of the Society of Automobile Engineers, held on the waters of the Great Lakes, and never before has the art of automobile engineering received a mightier forward impulse. Characterized by fine attendance, the frankest of discussions and the laying aside of prejudice and the personal feeling which often interferes with pure analysis, this meeting has been a success from the supreme standpoint of accomplishment.

The professional part of the program included sixteen papers and twelve reports of standards committee divisions. Of these fourteen of the papers were read and the entire standards program carried out. Of the twelve standards reports six have gone far enough to be submitted by letter ballot according to the new procedure to members of the society, and the other six were progress reports.

President VanDervoort's handling of the meeting attracted favorable comment on all sides. Particularly noticeable was his success in bringing men vitally concerned in a subject into the discussions. The attendance at the individual meetings, even with the highly specialized subjects, hardly ever dropped below 100 and was generally above that figure. Keenest interest was exhibited throughout the meeting. The new procedure of the standards work in submitting approved reports to the members for mail vote was carried out successfully, and these matters will soon be presented.

The Noronic's main salon in which the meeting was held gave ample space for the meeting, and in fact the manner in which the meeting was conducted proved so satisfactory that it is proposed to hold an entire week trip next summer.

The keynote of the entire meeting was without doubt the discussion which followed the paper by A. P. Brush, of the Brush Engineering Association, which brought up the question paramount in the minds of the public as well as those professionally connected with the automobile industry: What is the proper number of cylinders? To briefly summarize the

points made in this discussion into a concrete line of thought, one who listened to the discussion would carry away with him the impression that the keynote of the entire situation is the displacement per cylinder. Between 40 and 50 cubic inches per cylinder seemed to meet the ideas of quite a few who participated in this discussion to a nicety. The problems presented by extreme high-speed motors with excessive high-gear ratios were also examined from many different angles.

The discussion brought out by the paper on Farm Tractors and Their Motors by Philip S. Rose was another high spot in the meeting. The discussion hinged upon

the point of good performance at low price. The duty of the farm tractor is a strenuous one in that the motor must be operated for long periods under full load. This puts a high performance demand upon the motor and at the same time the farmer will not consent to high prices. The price limita-





Listening to the papers on board the Noronic, where the engineers held their meeting while cruising the waters of Georgian Bay

tion for practice in considering the market containing the mass of buyers seemed to be between \$600 and \$1,000.

Another discussion which will stand out in the minds of those who attended was that on the paper entitled Aluminum Alloy Pistons, by Eugene Gruenewald.

No Objections Offered

The big point in it was that no one seemed to have anything to say against the aluminum piston and there did not seem to be any doubt in the minds of those present that aluminum pistons have come to stay. The question of slap which has been brought up in the past was again brought up, but it seemed to be the consensus of opinion that while the slap does occur for the first few explosions, it is lighter than a cast-iron piston slap and does not bother the car owner.

Other papers which were provocative of interesting and

instructive discussions were Automobile Clutches, W. F. Hurst; A Formula for the Comparison of Automobile Performance, C. T. Myers; Rational Method of Electric Vehicles, T. H. Schoepf; Increasing Truck Efficiency with Trailers, A. R. Miller; Automobile Lubrication, C. W. Stratford; Spiral Bevel Gears, A. L. Stewart; Pressed Steel Wheels for Pleasure Cars, Orrel A. Parker; Spring Design, C. H. Gleason.

The Standards Committee reports, which have been adopted for decision by letter vote, are those of the division on carburetor fittings, electrical equipment, electric vehicles, iron and steel, miscellaneous and springs. Statements of progress were made by the divisions on ball and roller bearings, chains, international standards, lock washers, and truck standards. These reports are largely the result of the April meeting of the standards committee and cover the points mentioned at the time of that meeting.

In bringing the business sessions to a close, President W. H. Van Dervoort introduced Captain J. S. Critchley, past-president of the Institution of Automobile Engineers of Great Britain, now acting as inspector of the Motor Transport Division of the British Army, who was on board. Captain Critchley is now working on the truck war orders being filled by American manufacturers. In addressing the members, Captain Critchley stated that the I. A. E. had planned for the S. A. E. trip last year and was greatly disappointed that war conditions prevented their coming. He, however, expressed the wish that the trip would be made at the conclusion of the war, and also said that the English engineers were looking forward to a trip over here. Speaking of the impressions gathered during the discussions, he stated that it is interesting to note the development of the American automobile engine, and though their high-speed type has been studied to a greater extent in Europe, it is evident that the Americans are now taking it up with enthusiasm. Regarding the multi-cylinder engine, he expressed his belief that this will force the higher development of the others.

Winter Session 1 Day

President Van Dervoort mentioned the appreciation which was felt of the close relation between the two societies and hoped for many pleasant exchanges in the future.

Speaking of the winter meeting, which will be held in New York, in connection with the New York Show, the president announced that this meeting will be for 1 day only, the standards committee meeting on the Wednesday of show week, and the session will take place all day Thursday, with a dinner at a prominent hotel in the evening. By this method it is hoped that a very full attendance will be had and a rapid conclusion of the business program.

Several suggestions have already been made regarding the next summer's meeting, and the consensus of opinion seems



Picnicking on Sans Souci, one of the Thirty Thousand Islands of Georgian Bay

to be that the cruise this year was a day or 2 too short. Many felt that they would like to make an entire week's trip, and the idea of going to Duluth was submitted. It was pointed out that the Great Lakes seem to be the most ideal for a cruise of this kind.

Votes of Thanks

The agitation for a Chicago section was mentioned and bids fair to become a reality. There are 175 members in the territory around Chicago, and many are of the opinion that a strong section should be formed there. The October meeting of the standards committee is to be held in Chicago and at that time an effort will be made to start the section. President Van Dervoort has written to all members in that territory, and up to the present he has had 65 favorable replies.

Votes of thanks were unanimously carried in appreciation of the work of the meetings committee, the Detroit section for the arrangements made, the Daily S. A. E. which enlivened the trip greatly, the work of the steamship officials and the crew in taking care of everything so nicely, the music furnished by the Packard band when the boat was leaving Detroit, and the courtesy of the various Detroit concerns for lending cars to take the people to the boat and around the city. A rising vote of thanks was also tendered President Van Dervoort for the very efficient manner in which he conducted the sessions and put things through. The latter voiced his personal appreciation of the attendance at the meetings, of the interest shown and of the close harmony in the Society's work. He hopes for many more cruises of the same kind on the Great Lakes.

During the trip, exceptional opportunity was obtained for social enjoyment and for recreation. Arriving at Midland, Ont., on Tuesday afternoon at about 5 o'clock, the members of the party immediately gathered through the village and organized parades.

Tuesday night an entertainment was furnished by the Metropolitan section, including a playlet entitled, *The Sad Mystery of the Wiggle Drive*, which depicted the war order as the cause for the adoption of the Wiggle drive and a series of tableaux vivants representing the past presidents of the society. Wednesday night, the Detroit section entertained with a minstrel show, which scored a complete success. A dancing contest held just before the boat returned to Detroit was won by Miss Polly Souther, daughter of Henry Souther, past president of the Society, and John W. Watson, President of the American Bronze Co.



City Queen above and Waubic below, the shallow draft vessels which took the engineers through the channels among the Thirty Thousand Islands

The only professional session held on Wednesday was in the evening, the whole day being taken up by the cruise on the smaller vessels through the islands. A stop was made at one of them, San Souci, for a short time during the afternoon and a picnic enjoyed. The party then re-embarked and were carried through the narrow island channels to Parry Sound where the large steamer was rejoined.



Left, members of the meetings committee: E. T. Birdsall, consulting engineer; J. G. Perrin, consulting engineer Continental Motor Mfg. Co.; Robert McAllister Lloyd, consulting engineer, and Joseph A. Anglada, consulting engineer. Right, members of the nominating committee: Howard Marmon, engineer Nordyke & Marmon Co.; David Fergusson, engineer Pierce-Arrow Co.; Henry Souther, Ferro Mach. & Fdry. Co.; President W. H. Van Dervoort, president Moline Automobile Co.; Coker Clarkson, general manager S. A. E.; J. G. Perrin, consulting engineer Continental Motor Mfg. Co.; K. W. Zimmerschied, metallurgist General Motors Co.

40 to 50 Cubic Inch Cylinders



President W. H. Van Dervoort, who conducted the S. A. E. convention

Brushisms

- 1—Speeds should vary 3 to 60 miles per hour on high speed.
- 2—Motor speed range 125 to 2,500 r.p.m. crankshaft speed.
- 3—Zone of satisfactory cylinder diameters from 2.5 to 3.5 inches.
- 4—Stroke bore ratios satisfactory between 1.33 to 1 and 1.5 to 1.
- 5—Power and flexibility best increased by adding more cylinders.
- 6—Eight gives 100 per cent. power increase over four with simple crankshaft.
- 7—Europe's motors not as high speed as newer American.

FUNDAMENTAL PROBLEMS OF ENGINE DESIGN



A. P. Brush, consulting engineer, author of engine design paper

IF A. P. BRUSH'S paper had been designed for the purpose it could not have brought out better discussion on the vital question of the number of cylinders. His paper was entitled Fundamental Problems of Engine Design, and in it he touched upon the high-speed motor, stating that this seemed to be the accepted design for motor vehicle use. He fixed the speed range of these motors as between 125 r.p.m. and 2,500 r.p.m., and the speed fluctuation of from 3 to 60 miles per hour on high. The stroke bore ratio he fixed at between 1.33 and 1.5 to 1, and in stating the zone of satisfactory cylinder diameters he gave from 2.5 to 3.5 inches. Mr. Brush stated that fours will always be used, that the six represents an increased comfort value, as does the eight, due to the increase in number of impulses per revolution. He also says that the only justification for lengthening the wheelbase of the car for increased engine space and the introduction of a three-plane crankshaft is a 200 per cent. increase in impulses and a 200 per cent. increase in piston displacement over a four of equal dimensions. The discussion on this was participated in by many engineers who are vitally concerned with the subject and seem to bring out a consensus of opinion that it was a matter of piston displacement per cylinder, how many cylinders should be selected. The paper in part follows:

There is certainly a majority and probably a unanimous opinion among engineers that the small-bore long-stroke high-speed motor is the best adapted to automobile service, at least in pleasure vehicles. Let us make a brief analysis and see if we cannot accept this statement as an axiom, and base our further consideration of motor car engine design and construction upon this one fundamental truth.

In stationary work efficiency has pretty generally increased with the size of the cylinder, but this apparent contradiction can be easily rationalized if we begin at the beginning and consider the conditions and requirements of the class of motor

car service in question. In the first place, weight reduction is a prime requirement; and relatively high speed is the most obvious method of securing weight reduction. In the second place, the class of service under consideration demands flexibility throughout a range unapproached in any other service. If from three to sixty miles per hour be accepted as reasonable minimum and maximum road speeds on top gear, we have a 95 per cent. speed fluctuation, throughout which speed range our motors must operate satisfactorily at from zero to full power. In a high-speed automobile engine this might represent a speed range of from 125 revolutions per minute to 2500 revolutions per minute, a range not only not impossible but not even difficult. For an extreme comparison, let us assume an attempt to get the same speed range on a large engine capable of say a maximum of 100 revolutions per minute, and we have the impossible minimum of 5 revolutions per minute required.

Accept Small High-Speed Motor

It therefore becomes apparent that we can accept this small high-speed engine as the best adapted to automobile service because of low weight and flexibility.

From this much of our analysis we might conclude that the smaller the cylinder diameter the better, but there is also one fundamental reason why the piston diameter should be kept as great as is consistent with continuous operation at full load and maximum speed, namely: the superficial area of similar volumes varies as the square of their similar line dimensions, while the volume varies as the cube of their similar line dimensions. This means that the smaller the combustion chamber, the greater is its superficial area in proportion to its volume, and consequently at a given rate of speed, the greater will be the amount of heat lost through the relatively cold confining walls.

Two fundamental necessities in motor car service (light weight and great flexibility) can be met satisfactorily only by a motor design capable of continuous operation under full load at speeds at least as high as 2500 revolutions per minute. From the preceding analysis it is obvious that the piston and exhaust valve diameters will be definitely limited, if satisfactory performance and durability are to be secured in the

hands of the average user, and it is equally demonstrated that we must not go too far below these limits if satisfactory efficiency is to be secured, because of the already noted geometrical fact of relative volume and area ratios, in connection with the pre-heating and cooling effect of combustion chamber walls.

I will not attempt to say just what the best compromise between these two conflicting limitations is, but in my opinion the zone of satisfactory cylinder diameters lies between a maximum of 3.1-2 inches and a minimum of 2.1-2 inches, and I shall base further consideration upon this assumption as stated.

Very satisfactory power curve characteristics can be secured with a stroke-bore ratio as high as 1.5 to 1, and the cylindrical type of cylinder construction and valve arrangement will show with as low a ratio as 1.33 to 1 superior efficiency to that of the longest stroke L-type cylinder construction which it is practicable or advisable to use.

Let us assume, for the purpose of further discussion, that a cylinder of 3 inch bore and 4.1-2 inch stroke, with inverted or overhead valves, will give the highest average efficiency and still meet satisfactorily the requirement of continuous performance under full load at speeds at least as high as 2500 revolutions per minute, or in other words when subjected to maximum temperatures and pressures at least as often as 1250 times per minute.

Number of Cylinders

These cylinder dimensions give a displacement of approximately 32 cubic inches and can safely be relied upon to give, in the hands of the ordinary user, at least 3.2 horsepower at 1000 revolutions per minute (500 cycles per minute), and to approximate proportional power delivery throughout a wide range of higher and lower speed.

If two of these cylinders be combined in a two-cylinder engine, we have double the piston displacement per revolution with less than double the total engine friction per cylinder, and again, if the number of cylinders be doubled, we again double the piston displacement but do not quite double the total engine friction per cylinder. In fact, increasing the power by multiplying the cylinders has a tendency to increase the efficiency of an engine so long as the same power per impulse is required.

The only problem which tends to decrease efficiency, as the number of cylinders is increased, is the problem of uniform and adequate charging of the cylinders.

I assume that no one will question the axiomatic truth that all other things being equal, the greater the number of impulses per revolution of the crankshaft, the greater will be the flexibility of the motor. This increase in flexibility due to increased cylinder numbers is of maximum value in

automobile service, because it is an increase which is added entirely at the lower end of the speed range.

There is obviously no reason for discussing any number of cylinders less than four, as it has been conclusively demonstrated that that number gives the least number of impulses per revolution of cranksnaft that will be tolerated by the most economical class of motor car buyers. I believe that the four-cylinder motor will continue to be standard for the lowest price class of automobiles so long as the four-cycle internal combustion engine continues to be the accepted source of power for this type of vehicle.

As I have already pointed out, two exceedingly important factors in the comfort value of a car, namely, power and flexibility, can be bettered by increasing the number instead of the size of the cylinders, with less sacrifice of fuel efficiency and with an actual gain in durability.

Let us now compare the two first steps beyond the four-cylinder vertical motor in relation to increased comfort value. I refer to the six-cylinder vertical and the eight-cylinder V-type motors.

For purposes of comparison let us assume the same cylinder dimensions, 3 inch bore and 4.1-2 inch stroke. The six-cylinder motor will give an increase of 50 per cent. in power; the number of impulses per revolution will be increased 50 per cent. The cost of this increase will be the two extra cylinders with their pistons, connecting-rods, valves, valve operating mechanism and other minor supplemental parts. Also we must depart from the simple all-in-plane crankshaft of the four-cylinder motor, and to keep the same passenger capacity we must increase the wheelbase of the car something over two cylinder-diameters.

Eights and Twelves

The advantages of the eight consist in a 100 per cent. increase in power and a 100 per cent. increase in number of impulses per revolution. The increase in the number of major working parts is, as in the six, substantially in proportion to the number of cylinders added. I say substantially, because we must except two of the major working parts, the crankshaft and camshaft with their inter-connecting gear, the number of these parts being the same independently of the number of cylinders.

In the eight V, however, we have this much less price to pay for the greater increase in power and flexibility: the crankshaft remains of the four-cylinder all-in-plane type; the increase in wheelbase need not be more than half of one cylinder-diameter.

I think, therefore, that we must conclude that the eight-cylinder V-type motor makes possible a decidedly greater increase in the comfort value of the car, as effected by motor performance, than the six-cylinder vertical, at a cost in dollars and cents and in car weight at least as low.



David Fergusson, chief engineer Pierce-Arrow company; Russell Huff, engineer Packard company; Howard Coffin, engineer Hudson company; D. McCall White, engineer Cadillac company, and Howard Marmon, Nordyke & Marmon Co., who took part in engine discussion

As a corollary to this, I think we must conclude that any lengthening of the wheelbase of the car, for increased engine space, and the introduction of a three-plane crankshaft, can be justified only in case we wish to secure a 200 per cent. increase in number of impulses per revolution and a 200 per cent. increase in piston displacement over a four of equal cylinder dimensions; or in other words, if we wish to increase the comfort value of the car as affected by engine performance up to the point where the twelve-cylinder V-type motor is advisable.

In connection with V motors in general, some interesting facts in major vibratory tendencies appear. Taking the V four, for example, if all cylinders would work properly on a single crankthrow, as compared with the vertical four of the same cylinder dimensions, all major vertical vibratory tendencies would disappear and in their place would be found a horizontal vibratory tendency just twice as great as the vertical vibratory tendency of the vertical four.

In the V eight as compared with the vertical four of the same cylinder dimensions, the vertical vibratory tendency disappears and in its stead there is a horizontal vibratory tendency of the same general characteristics, 1 3-7 times as great as the vertical vibratory of the vertical four.

In this connection it has been interesting to observe that a properly constructed chassis seems much better able to absorb this horizontal vibratory tendency than the vertical vibratory tendency of the vertical four.

The V twelve seems to have the same major vibratory tendencies and characteristics as the vertical six; that is, instead of a tendency to reciprocate the entire motor mass with four reversals per revolution of the crankshaft, as in the vertical four and V eight, there is a tendency to set up periodic vibrations within the motor mass, the amplitude of these vibrations being in proportion to the work the engine is doing.

This six vertical and twelve V vibration seems to be a function of crankshaft flexibility. This was met more or less successfully some years ago by some of the foreign engine builders by use of a friction damping method. What we might term the American method of overcoming it, by increased crankshaft and crankcase rigidity, is, I think, much more scientific and workmanlike.

Overhead-Valve Construction

I have referred previously to the fundamental advantages of the inverted- or overhead-valve type of construction and made the statement that the problems of valve operation had been solved satisfactorily. In proof of thermal advantages of this type, I would like to call your attention to the fact that in automobile engines this is the only cylinder type which has survived in the direct- or air-cooled engine; and I believe this survival has been due almost entirely to, first, the inherent thermal superiority of this cylinder form, and, second, the brilliantly simple manner in which the problem of valve operation has been met, a method so simple that it has apparently escaped the general attention.

The overhead rocker type of valve-operating mechanism has been criticized as being noisy, because of the greater mass of the moving parts involved. With valve rockers pivoted at their centers, this is an obvious and inherent defect. It is the



Victor Page, engineer New Departure Co.; A. Ludlow Clayden, engineering editor THE AUTOMOBILE, who participated in discussion on engine design

Franklin company's practice to locate the rocker pivot twice as far from the center line of the valve stem as from the center line of the push-rod. This means that for the same valving characteristics, the cam-rider, the push-rod, and the push-rod end of the rocker have just half the movement, and consequently half the maximum velocity of the valve, and in turn just one-fourth the kinetic value in proportion to their weight, with the result that the kinetic value of all of the moving masses of the valve-operating mechanism is nearly if not quite as low as in the average practice in L or T type of engine designs.

The selection of this best commercially possible thermal cylinder and valve arrangement, in connection with the really splendid bit of engineering skill, has secured commercial quietness of valve operation in the air-cooled type of engine mentioned, in which owing to the lack of water jackets quietness is most difficult to achieve.

I believe that by taking one more step we can make this indirect valve-operating mechanism commercially superior to any other known type. By making the position of the offset rocker-pivot adjustable, the adjustment parts thus becoming stationary, in connection with the offset rocker and lightened moving parts there will be secured kinetic values at least as low as those of the best direct-action types, in proportion to the effective valving. In addition we attain a convenience of adjustment for the user that has not been approximated heretofore in any constructions with which I am familiar. President Van Dervoort declared the paper open for discussion.

F. E. Moscovics opened the discussion on this paper by saying, "I wish to take exception to Mr. Brush's suggesting the limiting of 'useless experimentation.' Think back 6 years. And how many of the developments since that time have been the result of so-called useless experimentation?"

"I would like to ask," continued Mr. Moscovics, "what is a high-speed motor? How many r.p.m. would constitute a high-speed motor?"

Mr. Brush replied that he was having the misfortune of being constantly misunderstood during the progress of the session. He said, "If you should put your hand upon a hot stove, and that stove should burn you, any placing of the hand upon that stove subsequently would be useless experimentation."

Herbert Chase, engineer of the Automobile Club of America, said regarding the minimum area of the combustion chamber, that he could not see the practical advantage in limiting the combustion chamber area since greater wall area does not make a material difference. "We should give less attention to theoretical limits of wall area and more attention to the adjustment of the carbureter, since a small turn of an adjusting screw makes a tremendous difference."

Mr. Brush replied that the reason he has selected a four-cylinder car in his paper was simply to narrow the discussion to this point. "As to temperature of cooling water."



Scenic view among the Thirty Thousand Islands of Georgian Bay, through which the engineers took a side trip



Panorama characteristic of the waters of Georgian Bay, through the islands of which small steamers conveyed the S. A. E. party

he said, "this is immaterial, as to base conclusions on this would be to base them on uncertain premises. The change of the inside temperature is less than the change of the temperature of the water. The cylinder wall only takes the heat from a small layer of gas adjacent to the wall of the cylinder. Understand," Mr. Brush continued, "we do not advocate that the design of the carbureter shall be neglected for engine design, but rather that both should be studied independently."

Asks for Multi-Cylinder Men

President Van Dervoort asked for the champions of the sixes, eights and twelves, stating that the engineers were anxious to hear them.

C. W. McKinley, engineer of the Willys-Overland Co., told of experiments of a similar nature on two types of motors having the same displacement, but one of which had a spherical combustion chamber and the other had a very flat chamber. These experiments were carried out to maintain a parallel between the two motors and under similar working conditions. These tests, according to Mr. McKinley, showed little or no variation between the two motors, and he expressed it as his belief that there is really little effect due to the shape of the combustion chamber. He further stated that the design of the intake is as important as any other point and that in present designs it is necessary to make a sacrifice in maximum power and speed in order to secure the best starting. In other words, he pointed out that the intake manifold design is a compromise between the securing of high power and the facility of starting and running at idling speeds.

Professor F. R. Hutton called attention to the part of the paper which states: "The strength of any structural element of any given material increases inversely in proportion to its size. To illustrate, a steel ball 1 inch in diameter will carry several thousand times its own weight, while a ball of the same material one mile in diameter would fall apart of its own weight."

Professor Hutton pointed out the mathematical error in the way the statement was made in the paper. To this criticism Mr. Brush replied that he did not intend the expression in the manner in which it was printed, but meant to state instead that the proportion held, but not in a direct ratio.

C. T. Myers, engineer of the Timken-David Brown Co., said: "Mr. Brush has assumed many fundamentals. Along the present line I believe the four-cylinder motor to be capable of higher development than any other type."

Victor Pagé, experimental engineer of the New Departure Co., in a contributed

written discussion stated that the big objection against the multi-cylinder engines is in their added repair expense. He believes that the number of cylinders justified to secure easy running should be used, but after the justified number is reached the designer should endeavor to make things as easy for the operator of the car or the ultimate consumer as possible. Fewer vibrations, smooth power application and the other products of the large number of cylinders will lessen the number of repairs necessary on the car, but there is always sure to be a certain depreciation and to men of only moderate wealth the cost of these repairs is sure to be a serious matter. The large middle class of buyers, who own cars, are not technically informed and hence simplicity is a great factor to be considered.

Mr. Pagé mentioned as a special example the grinding of the valves. "Suppose the operator traveled without the spark properly advanced. This would be hard on the exhaust valves due to the increased temperature of the exhaust and the result would be that the valves would need grinding at a much earlier time. When it comes to the cost of this operation I have done the work on a four-cylinder, block motor in 2 hours. On a singly-cast motor the work would take 3 hours. If the motor has sixteen valves it will take twice as long. At the usual garage rates the charges for the four-cylinder motor would be \$2.50, for the eight this would be multiplied by two and for the twelve it would be multiplied again. In the same proportion the charges would be multiplied for every piece of work done throughout the car. The result would be twin-multiple repair bills."

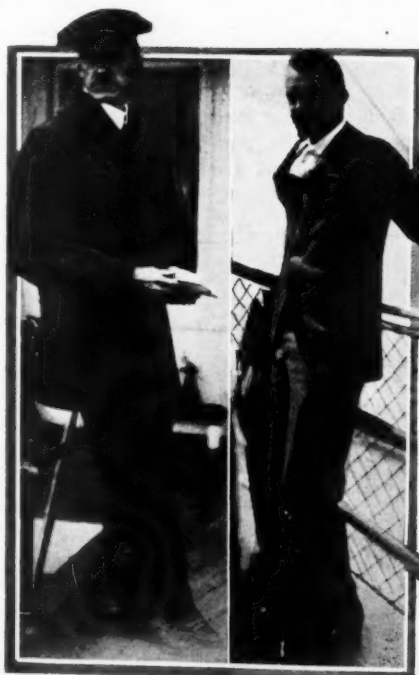
David Fergusson, engineer of the Pierce-Arrow company, in commenting on Mr. Brush's paper, said, "Mr. Brush's paper is of great interest in view of the rush for the high-speed motor of multi-cylinders. The medium-speed engine will last 10 years.

Europe has developed high-speed motors in the last 3 years geared 3.3 to 1 and they do not run at really high speeds unless at 70 or over miles per hour. At 40 miles per hour the engine speed is 1,300 r.p.m. and at 70 miles per hour it is 2,250; therefore, these motors running at medium speeds should have long life. Taking some of the eight-cylinder motors of American manufacture geared at 5 to 1, these make a higher speed than the European type. At 40 miles per hour they are making 1,900 r.p.m. and at 70 miles per hour they are making 3,300 r.p.m.

Larger Motor Sweeter Running

He went on to cite the example of Pierce cars, which are made in three sizes of motor, 4 by 5.5, 4.5 by 5.5

(Continued on page 1145)



William Stout, engineer the Scripps-Booth Co.; C. W. McKinley, engineer the Willys-Overland Co.

Spiral Type Bevel Gear



SPIRAL BEVEL PROPERTIES

Have longer life.
Less unit strain.
No greater wear.
Greater quietness.
More tolerance in
adjustment.
Higher gear ratios
possible.
Retain permanent
conjugate form.

A. L. Stewart, Gleason Wks., author of paper on spiral bevel

TAKING the paper entitled Spiral-Type Bevel Gears for Automobile Drives, by A. L. Stewart of the Gleason works as an indication it would seem that this type of gear had come to stay, for little if any adverse criticism was brought out in the paper itself or in the following discussion on this design. The general concession of long-life and noiselessness together with the admission that any loss in efficiency must be very slight was quite significant.

According to the author and those who followed him at the professional session of the S. A. E. longer life can be expected from the spiral type because of the greater surface over which the load is carried, in spite of the fact that the load in itself may be greater. Greater quietness and the possibility of a marked departure from absolute adjustment are other features. Speaking of strength and wear the author says:

Strength and Wear

Perhaps the most satisfactory way to consider the strength and wear of spiral-type bevels is by comparison with straight-tooth gears. For the same power transmitted, and other things being equal, the load on spiral teeth is greater than on straight teeth, because the spiral tooth must carry the additional thrust-load. This thrust-load varies with different angles of spiral, but assuming an angle of spiral of 30 degrees, the total load on the tooth is about 15 per cent. greater than the corresponding tooth load for straight-tooth gears. To offset this extra load the spiral-type gear has more teeth in contact at all times than the straight-tooth gear. Assuming that the spiral lead is such as to give an overlap equal at least to once the circular pitch, there will always be one more tooth in contact. While the contact of the extra tooth will not be full-length, still it will be more than enough to make up for a 15 per cent. increase in load. That is to say, spiral teeth, while they have a greater load to carry, have that load so distributed as to put less strain on

No Adverse Criticism Found in Discussion

each tooth. We have known of very severe tests of an electric car spiral-type drive in which a nine-tooth six-pitch pinion running with a sixty-six-tooth gear with a face length of 1 1-4 inches, has stood up under repeated reversals of the motor when running at high speed. The total load, including three passengers, was about 4,000 pounds. The pinion was made of 5 per cent. nickel steel case hardened, and was, of course, solid with the shaft.

Referring again to the comparison of spiral-type bevel gears and helical-spur gears with parallel axes, it will be seen that inasmuch as the spiral-type bevels have no more sliding action than straight-tooth bevels or spurs, there will be no more tendency to wear from the nature of the action. This can be seen from another point of view, by considering a spiral-type tooth as made up from a straight tooth which has been cut into a number of sections normal to the tooth, the sections or laminae then being offset with respect to each other, or stepped, so as to conform to the spiral curve. Each section would then roll with the corresponding section of the mating tooth with the rolling action of straight-tooth gear. If the number of sections is increased the tooth approaches a spiral type tooth with a smooth curve, but the increase of sections does not introduce any more sliding action. A spiral type tooth may be considered as made up of an infinite number of such sections each infinitely thin, but the action will still be the same. Thus if there is no increase of sliding action, the only condition which will tend to increase the wear is the increased tooth load. The length of tooth measured along the spiral is, however, increased in the same proportion as the load itself, so that the unit pressure is the same as for straight teeth.

Contrasts Spiral and Worms

In opening discussion on A. L. Stewart's paper on spiral-type bevel gears, C. J. Fitzpatrick asked whether the spiral spur gear were not more like a worm than the spiral-type bevel. Was not the spiral-type bevel an essentially different acting gear from the spiral spur gear? Mr. Stewart said the spiral forms were all alike in action as long as the axes were parallel. If the axes are not parallel a spiral tooth gear is akin to a worm. C. J. Fitzpatrick then asked if there were more distortion in hardening the spiral-type tooth bevel gear and Mr. Stewart replied in the negative.

Henry Hess, asked whether any members had data on the advantages of different tooth forms as opposed to gear forms. Was there anything to choose between the involute form and the Bilgram octoid, for instance? He pointed out that where a spiral-type bevel tooth is coming into the loaded area the part of the tooth in contact is supported by the part out of contact the latter acting as a flank. There was no difference as regards sliding between straight or spiral forms of tooth.

A. P. Brush, said that he would like to suggest a qualification to Mr. Stewart's statement that all gears with axes parallel are equivalent to an infinite number of infinitesimal straight tooth gears arranged in a curve. He would say that this was true of all gears with the axes in the same plane. The reason for the great durability of spiral gears is that there is always pitch line contact on the teeth in contact owing to the overlap of tooth by tooth. Slip or rubbing takes place as the point or line of contact on a tooth departs from the pitch line, thus a straight tooth will always wear away faster above and below the pitch line, than on

the pitch line. In the spiral gear, as there is permanent pitch line contact, no other part of the tooth can possibly wear away faster than the pitch line part, which means that a conjugate form of tooth is maintained despite wear.

In the spiral-type bevel cut with a straight sided cutter the tooth is an octoid and not an involute, but both forms for the short length used are practically identical.

Henry Hess begged to differ from Mr. Brush, there was no form of gearing which would retain original tooth form. A gear ought to do this but never really did so. The discovery of a form of gear tooth which would retain its original form had been sought for a very long time and the solution of the problem would be of immense importance.

Mr. Brush, explained that he did not intend to give the idea the spiral tooth retained its original form, but that, owing to the continuous pitch contact, it retained a permanent conjugate form.

President Vandervoort called attention to the valuable feature of the spiral-type bevel in needing less accurate meshing to give good results.

Adjustment Toleration

H. W. Alden said he had made experiments to see how much the cone center could be shifted and found it could be rotated around a sphere 1-16 inch diameter. That is, the pinion could be moved 1-32 inch out of the theoretical position in any direction without creating undue noise. Regarding the question of tooth face wear raised by Messrs. Brush and Hess, if a pair of straight tooth bevels are taken and examined after use a distinct line can be seen marking the pitch contact of tooth on tooth. With the spiral gear the surface is polished evenly all over and there is no line to be found. He asked for information concerning the strength of pairs of gears with the same ratio and number of teeth since, although the tooth in the spiral gear would be longer, it would also be thinner. He would like to hear if any tests had been made. Practice showed that trouble with broken teeth was less common with spiral than with straight tooth gears.

Mr. Hess called attention to the Wilfred Lewis machine for testing the strength of gears both ultimate and as regards durability. This machine was now at one of the universities and he suggested as the subject was so very important the research committee of the S. A. E. might consider financing or aiding the making of tests.

David Landau said the machine which Mr. Lewis had built most recently was at the Massachusetts Institute of Technology.

Mr. Brush, remarked that tooth strength was of no im-

portance practically though it might be so academically, since to give necessary durability the ultimate strength is greatly in excess of the necessities of load support. Regarding the tooth formation Mr. Stewart had said the bevel tooth as now used was not a true spiral, but since there are so many true spirals of different kinds he would like information as to Mr. Stewart's exact meaning.

Mr. Stewart replied that Mr. Brush was correct in saying there were many true spirals but the tooth used in the spiral-type bevel was none of them.

Ray Johnson asked whether a nine-tooth pinion had been tried with spiral-type bevel gearing. It had been stated that ten and eleven teeth had been tried successfully and he would like to know whether it was possible to go further than this in view of the demand for even lower ratios to suit high speed engines.

President Vandervoort said this was a pertinent question and brought in the question of tooth strength because, as we used lower gear ratios, there arose a desire for finer pitches.

V. R. Heftler of the Zenith Carbureter Co. spoke regarding the Citroen double-helical bevel and said he had seen successful five-tooth pinions with this form of gear. The double helical or herringbone bevel gear was made with an end mill and could be cut to any desired true spiral form.

C. T. Myers, said that while Messrs. Brush and Alden expressed perfectly accurate practice, Mr. Hess was none the less correct on the subject of tooth wear. If there were true rolling at the pitch line there would be no wear, but as spiral-type bevel teeth touched all over, if there was any rubbing the pitch line was forced to rub just as much as any other part of the tooth face. Whatever rub takes place occurs equally all over the tooth. Comparative tests of worm and other gears should be accepted with caution because it was never possible to be sure that any test was carried out with both forms of gear working under the best conditions. In a properly designed and mounted worm gear the oil film is never broken down and the strength of worm tooth is so greatly in excess of that of any bevel tooth that it is not worth discussion. Worm gearing, if correct, will outlast the rest of the car and is practically indestructible so long as it is properly lubricated. Also since the worm is hard steel and the wheel soft bronze, any wear takes place in the latter. The hard worm retains its true shape and maintains that true shape on the bronze of the wheel. Just as good a mileage per battery charge in an electric vehicle could be obtained with worm as with any other form of gearing.

Mr. Hess said that if we could keep an oil film always unbroken between the surfaces of any sort of gear and also keep out all grit the gear would be everlasting.



Deck scenes, typical of cruise of Society of Automobile Engineers' members and their families on waters of Georgian Bay

S. A. E. Standards Committee Work

Six Reports Adopted, Six of Progress

Reports Adopted

Carbureter Fittings
Standards Exchange
Electrical Equipment
Iron and Steel
Miscellaneous
Spring Division

CARRYING out to the letter the program of the standards committee as given in THE AUTOMOBILE for June 17, notable strides have been made in this important work. Adoption of a report by the society in its open meeting now means that the report is submitted to the society for a letter vote and this must be taken before the practice really becomes adopted as an official standard. This guards against any possibility of standards being passed at meetings of small attendance.

The divisions whose reports are now ready for this vote are those dealing with carbureter fittings, standards exchange, electrical equipment, iron and steel, miscellaneous and springs. Progress reports were made by the electric vehicle, ball and roller bearing, truck standards, chain, international standards and lock washer divisions.

Jerome J. Aull, mechanical engineer, the Lunkenheimer Co., summarized the report of the carbureter fittings division. K. W. Zimmerschied in commenting upon this remarked that there had been considerable controversy among members of the trade concerning the standard hot-air stove for attachment to the exhaust manifold, and read a letter from the Mossberg company expressing itself as desiring standardization and being in favor of the integral type in which the stove is cast as a unit with the manifold. They also mentioned, however, advantages of the pressed-steel type over the integral due to the fact that the unit casting requires some difficult core work.

Mr. Zimmerschied suggested that provisions be added to the report providing for the pressed-steel stove and further stated that perhaps many firms would find the latter more desirable and that it should be included.

Mr. Aull advised that it is the intention of the division to include the pressed-steel type and that perhaps paragraph 14 of the report which reads, "To overcome these defects and to obtain a measure of uniformity where confusion now exists, the carbureter fittings



K. W. Zimmerschied, metallurgist of the General Motors Co., chairman of the Standards Committee.

division recommends the practice of casting a cored passage of suitable size and shape integrally with the exhaust pipe, whenever it is practicable to do so; this device to be known as "carbureter air heater," is somewhat too strong. Paragraph 24, however, corrects this as it states that carbureter air heaters differing from the type shown, whether integral with the exhaust pipe or separate attachments, should have heating surfaces and areas at least equal to the type shown in the sketch suggesting the integral design. As regards the difficulties of coring, Mr. Aull contends that the manner in which the design is worked out in the illustration provided with the report of the division, gives a satisfactory coring arrangement that should not prove difficult.

The report was carried and will be presented to the society for a vote by mail in accordance with the new procedure in the adoption of standards.

Zimmerschied's Report on Bell Housings

Chairman, K. W. Zimmerschied of the standards committee in reporting on bell housings for the motor crankcase and port end of gearboxes in unit power plant designs, advised that the power report has been held to. He said: "Your defunct

Progress Reports

Electric Vehicle
Ball and Roller Bearings
Truck Standards
Chain Division
International Standards
Lock Washers

bell housings division known as the standards exchange committee met with some trouble on account of last year's report and another meeting was held to revise this matter in accordance with letter which have been received from interested concerns. The result is that they have practically held to that report merely changing a few details in the flange dimensions."

It was decided that the report as given be presented to the membership for a letter vote.

Electrical Equipment Division

The report of the electrical equipment division by W. H. Conant, manager of the Detroit branch of the Gould Storage Battery Co. chairman of the division, provoked no discussion and will be presented by the committee to the society for a mail vote. This will make interchangeable the single-wire system plug ends with bulb bases of the two-wire systems.

Iron and Steel Report

The important report of the iron and steel division was summarized by K. W. Zimmerschied metallurgist of the General Motors Co. and chairman of this division, who reported that the new matter in the report raises the minimum vanadium percentage from .12 to .15. A new steel known as 3330 which is a nickel-chromium steel midway between 3320 and 3340, has been added.

The most important addition is the introduction of the physical properties of carbon steel. Mr. Zimmerschied said that from time to time, additional notes on the physical properties of the S. A. E. steels will be added. The paragraph relating to gray cast iron was stricken out, but the paragraph of the report referring to malleable iron was left as it stands. This chemical formula for malleable iron gives the manganese as .30 per cent. to .70 per cent., the phosphorus not to exceed .20 per cent., sulphur not to exceed .06 per cent. and silicon not to exceed 1.00 per cent. Recognizing the wide variance in methods used for the determination of sulphur, the final reference method shall be the gravimetric (aqua regia) method, by oxidation.

This report will be presented to the society for a vote by mail.

The report of the miscellaneous division made by J. G. Utz, Consulting Engineer of the Perfection Spring Co. combined a report of definite methods of procedure and of progress on other parts and contained a suggested set of limits on brake linings given at the meeting. In tabular form this was as follows:

Limits	Plus or minus Wide/thick	.010 1/8	Brake Linings			
			Plus 0 minus 1/32	1/4	5/16	3/8
	1	X	X	X		
	1 1/4	X	X	X		
	1 1/2	X	X	X		
	1 3/4		X	X		
	2		X	X		
Plus 1/32	2 1/4		X	X		X
Minus 1/16	2 1/2		X	X		X
	2 3/4		X	X		X
	3		X	X		X
	3 1/2		X	X		X
	4		X	X		X
	4 1/2		X	X		X
	5		X	X		X

It will be noted that the 1-2 and 5-32-inch sizes are omitted and in regard to this E. A. Wales of the Royal Equipment Co. could not understand the omission of the 5-32 size as his company had over a certain period made 100,000 brake linings of this size and none of the 3-8 size. This matter was referred to the attention of the division as was a suggestion by Russell Huff, Consulting Engineer of the Packard Motor Car Co. that the limits be increased from plus or minus 1-32 inch to plus or minus 1-16. As regards the 3-8 size he thought trucks need it for countershaft brakes and that the demand for this size will increase. This suggestion as to the increase in the limits echoed an opinion by Henry Hess, President of the Hess Steel and other companies, that wherever possible limits should be large in order to decrease the cost of production and hence the cost to the ultimate consumer.

Mr. Utz stated that the division thinks the limits can be made wider and would concede that fact in drawing up the final report of the committee.

Henry Souther, Vice-President of the Ferro Machine & Foundry Co. said, "Mr. Utz has told me that he has had few replies to his letters endeavoring to secure some information leading to the formation of a report on pistons. This is too bad as it is necessary to standardize these, particularly since diameters are becoming smaller. I do hope, as a piston maker, that this will be given careful consideration as it will help ma-

terially in reducing cost, especially with the introduction of the alluminum-alloy pistons."

Mr. Zimmerschied formally moved that the plus or minus 1-16 inch limitation be incorporated in the report as a substitute for the limits given on brake linings and with this amendment it was voted that the report be presented to the society for a mail vote.

Electric Vehicle Division

R. McA. Lloyd read the report of the electric vehicle division. There is some doubt according to Mr. Lloyd as to the recommended standard voltages which are given in the report as 80 to 85 for one class of vehicle and 60 to 66 for another class. The outcome of the action on this point is still in abeyance. At the standards committee meeting, which preceded the general meeting, it was decided after considerable discussion, that the report did not refer to industrial trucks used in factories or railroad stations. These vehicles, it was said, operate most efficiently on much lower voltage.

Springs Report Suggests Changes

C. W. McKinley, chief engineer of the Willys-Overland Co. read the springs-division report which was in the main, the same as last year, the important additions including a drawing to bring out

the meaning of the wording regarding the standard test for the parallelism of eyes and master leaf of springs. The allowed variation from parallel has been changed to 3-16 inch from 3-8 inch.

The tolerances for eye bushings have been increased to make them agree with common practice and another alteration has been the dimensions of center bolt heads for both passenger and commercial cars. Another addition is that where rear springs are underslung 1-8 inch should be added to the clip diameter. In case the rear springs take drive or both drive and torque the spring eye should be 1-4 inch larger in diameter on the drive end. This is an addition to the tabulations covering the spring widths, eye diameters and clip dimensions.

Ball and Roller Bearing Progress

F. G. Hughes, chief engineer of the New Departure Mfg. Co. made a progress report for the ball and roller bearings division, the most important point of which is the standardization of certain bearing bores. It is proposed that the bores will be 5-8 to 1 1-4 inches progressing by 1-16 inch increments; from 1 1-4 to 2 1-2 inches by 1-8-inch increments, and from 2 1-2 to 4 1-2 by 1-4 inch increment. It is proposed to have both a long and short series and prepare a table of bore chamfers taking as a basis twice the S. A. E. ball bearing chamfer. A sub-committee is to be formed to take up the matter with the bearing companies both as regards the inch and metric sizes. The inch size will precede the metric.

Chairman K. W. Zimmerschied in reporting progress for the research committee said that the only matter on hand was that of tap drill sizes on which it was hoped to have a report at next year's meeting.

Chairman Zimmerschied also reported progress for the truck standards division stating that the most important matter before this body was the report on industrial trucks. He stated that the report of another organization was before the body at the present time covering this same matter and that the division would wait to see how this report made out before he would take any further action. The matter of tires for these trucks is before the body and they are at present undecided as to the number of sizes to be adopted and as to the advisability of exactly what sizes to keep and what sizes to abandon.



Jerome J. Aull, mechanical engineer the Lunkenheimer Co., Chairman Carburer Fittings Division



R. McA. Lloyd; Henry Hess, president Hess Steel Co.; Henry Souther, general manager Ferro Machine & Foundry Co; J. G. Utz, consulting engineer Perfection Spring Co.

Engineers Present on S. A. E. Cruise



Left to Right—E. E. Sweet, Consulting Engineer, Cadillac Motor Car Co.; Berne Nadell, Sales Engineer, Stewart-Warner Speedometer Corp.; George Briggs, Schebler Carburetor Co.; George Dunham, Consulting Engineer; C. W. Hatch, Perfection Spring Co.; Ray T. Middleton, Steel Products Co.; E. T. Birdsall, Consulting Engineer; G. P. Dorris, Engineer, Dorris Motor Car Co.



G. G. Bain, Chief Engineer, Hudson Motor Car Co.; James Diamond, Engineer, Aluminum Castings Co.; Max Bachem, Manager, Pressed Steel Wheel Dept., Detroit Pressed Steel Wheel Co.; Louis Marburg, Mechanical Engineer, Marburg Bros.



Howard Marmon, Chief Engineer, Nurdyke & Marmon Co.; and David Landau, Engineer of the Sheldon Axle Co.

Above—Herbert Chase, A. C. A.; C. J. Fitzpatrick; President W. H. Van Dervoort, The Moline Automobile Co., and Philip S. Rose

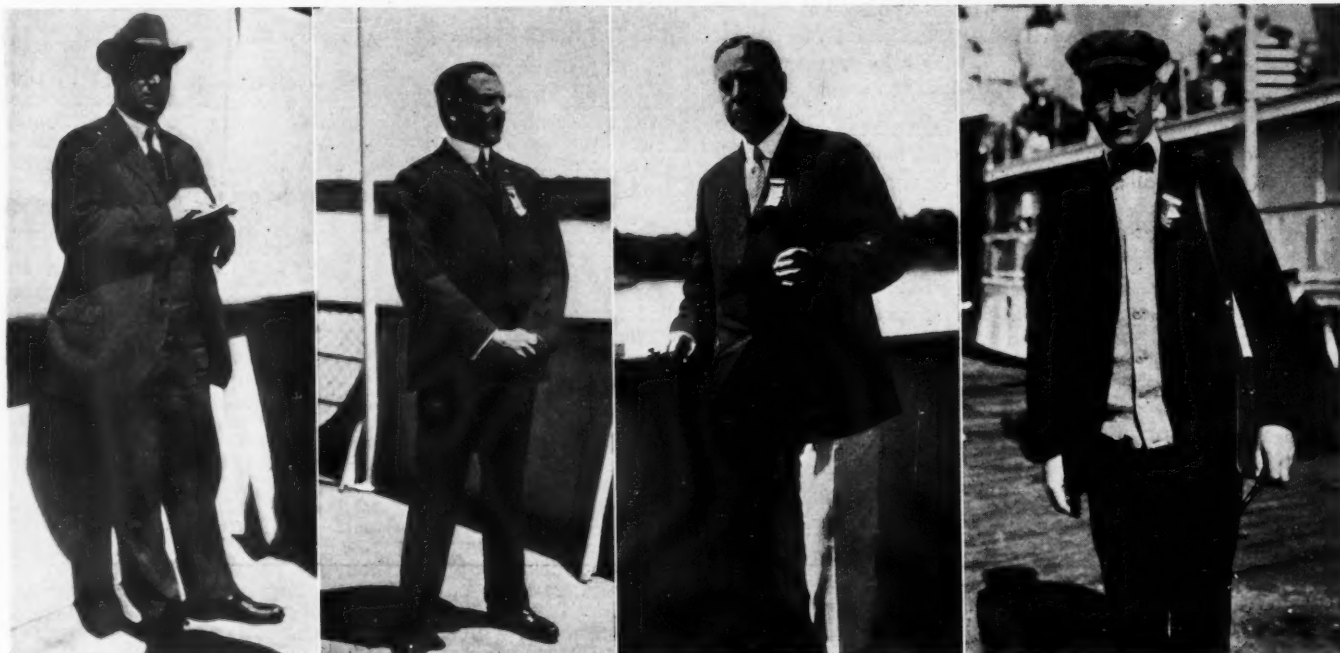
Right—H. E. Figgie, Assistant Engineer, Perfection Spring Co., and Oliver Barthel, Consulting Engineer.



J. E. Hale, Experimental Engineer, Goodyear Tire & Rubber Co., and F. L. Blackburn, Westinghouse Elec. & Mfg. Co.

Victor Pagé, Experimental Engineer, New Departure Mfg. Co.; B. Nauckhoff, Frank Mossberg Co., Attleboro, Mass.

Some of Those Who Read Papers



C. H. Gleason, Engineer, Kalamazoo Spring & Axle Co.—Spring Design; Joseph Anglada, Consulting Engineer—Motor Fire Apparatus; W. F. Herst, Factory Manager, Brown-Lipe Gear Co., Automobile Clutches; C. W. Stratford, Engineer, Pratt & Washburn Refining Co.—Automobile Lubrication.



Capt. J. S. Critchley, Past President of the I. A. E. of Great Britain, who addressed the meeting.



Arthur L. Stewart, Engineer, Gleason Works—Spiral Bevel Gears for Automobile Drives; P. S. Rose—Farm Tractors and Their Motors.



Neil MacCough, who read paper on Aeroplane Engines.



C. T. Myers, Engineer, Timken-David Brown Co.—A Formula for the Comparison of Automobile Performance; Albert R. Miller, Transportation Engineer, Troy Wagon Works—Increasing Truck Efficiency with Trailers; T. H. Schoepf, General Engineer, Westinghouse Elec. & Mfg. Co.—Rational Method of Determining Mileage of Electric Vehicles; P. W. Litchfield, Factory Manager, Goodyear Tire & Rubber Co.—Size and Inflation of Pneumatic Tires

Aluminum Pistons Pass Unchallenged

No Doubt Expressed at S.A.E. Convention as to the Success of the Lighter Alloys in the Small-Bore High-Speed Motors

Why

*Tensile strength as great as cast-iron piston metal
Good castings can now be made with consistent results
Less vibration of motor at higher crankshaft speeds
Less carbon deposit found on the heads of the pistons
Less wear on the main bearings and fewer overhauls
Cylinder walls less worn as aluminum pistons are soft
Aluminum pistons wear excellently with ordinary oiling
Weight reduction has quieting effect on whole motor*

ONE OF THE remarkable features of the meeting was that in the discussion following the paper on Aluminum Alloy Pistons, by Eugene Gruenewald, engineer of the Moline Automobile Co., not one statement to the effect that the aluminum alloy piston had not come to stay, was heard. In fact it seemed to be universally accepted as another of the interpretations of the small-bore, high-speed movement. The only point raised against the aluminum piston was the presence of a slight tap at the time of the first few explosions due to the great clearance necessary with the rapidly expanding metal. As this tap is so light and so soon disappears it was universally thought at the S. A. E. professional session, that this is no great disadvantage. In fact, it was pointed out that even this could be avoided by using an oil of higher viscosity. Mr. Gruenewald's paper follows in part:

The reduction in weight of reciprocating parts is of the greatest importance in the high-speed automobile engine practice, and it is the first aim of the designer to reduce the weight of the pistons. Many means to do this have been employed, but it has been found that commercially the aluminum alloy is the most suitable material for the purpose. The weight of the finished alloy piston is practically one-third of that of the gray iron piston.

About eighteen years ago it was discovered that with a small percentage of magnesium in the standard aluminum alloy the physical properties of the castings could be improved very much. Alloys based on this experience have made it possible to produce piston castings that will do the work as well as gray iron pistons. It is rather difficult to give an accurate

analysis of piston alloys, as foundries specializing in them do not care to give out full information. Analysis of the castings does not indicate the relative amount of magnesium, for example, as it burns out easily. Apparently, the basis of piston alloys is 96 to 97 per cent pure aluminum, magnesium and small amounts of copper, silicon and iron.

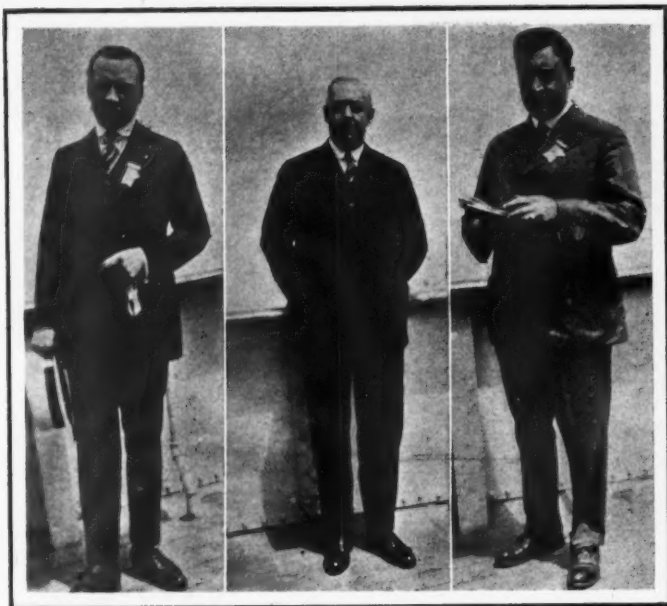
Design Is Important

The design of piston made of such alloys must be based upon the strength of the material and its coefficient of expansion. The tensile strength of the light-metal alloy is as great if not greater than that of the average piston iron, consequently aluminum pistons can be designed commercially the same as cast-iron pistons, except that the head should be 1-32 in. to 1-16 in. heavier, or, if of the same relative thickness as the cast-iron piston head, be reinforced by ribs. In a motor of 3 1-2 in. bore the heads of aluminum alloy pistons were purposely reduced to 3-32 in. thickness. Only under full load at a speed of 2,000 r.p.m. did the heads give out as a natural consequence of high temperature. These particular pistons were not reinforced by ribs; otherwise they would have withstood even such a severe test. Many aluminum alloy pistons, with a head thickness of 1-32 in. over the standard cast-iron piston thickness, and without ribs, have been in service in 4 in. and 4 1-8 in. motors for over three years, some of the cars equipped with them having covered as much as 60,000 to 70,000 miles, without the least indication of any weakness in the pistons.

The most important characteristic of aluminum alloy for pistons is its coefficient of expansion. The clearances cannot be the same as in the case of the use of cast iron. Furthermore, the clearance cannot be determined by the coefficient of expansion. Many tests have shown that light-metal alloy pistons vary in expansion as they differ in design. A straight-head piston has a different expansion than a concave- or convex-head piston of the same size. It is advisable to allow from .003 to .004 more clearance than in cast-iron practice, and then determine by dynamometer test whether the allowance is correct. A piston which has proper clearance will not rap after the first few explosions, or show any sign of a tight fit after the engine has been run at high speed and under heavy load. A few careful tests will determine quickly the proper clearances above and below the rings. If the foundries exercise care to maintain the alloy mixture, very little difficulty as to expansion will be experienced after the first tests. The piston-pin bearings also must be considered. The larger



Alfred Reeves, general manager, Automobile Chamber of Commerce, and Milton Tibbetts, Patent Counsel, Packard Motor Car Co., talking over axle matters. Right, group of editors of the daily S. A. E. published on the Noronic during convention



Chas. F. Splittorf, vice-president, Splittorf Electrical Co.; Joseph A. Atwell, New York Manager, Michelin Tire Co., and R. P. Johnson, general manager Warner Gear Co.

the diameter of the piston-pin, the greater the difference in expansion of the piston-pin and the boss on the piston. Consequently there is some danger of the piston-pin working loose, which is especially annoying in quiet motors on account of the possibility of a slight knock. Therefore, the piston-pin should be well secured in the piston to prevent any movement.

Advantages Many

It is not necessary to restate the various advantages of reduced piston weight as affecting the motor in general. Engines equipped with aluminum pistons have been in service for many thousand miles without the least sign of loose bearings. The accumulation of carbon on the piston head is reduced, on account of the cooling effect of the aluminum. The poppet-valve motor equipped with aluminum pistons can be kept in service for a greater length of time before it is necessary to remove the carbon than if equipped with cast-iron pistons.

Aluminum alloy piston wears excellently with the usual lubrication. One set of pistons which has been under observation has shown a quarter of a thousandth wear after 14,000 miles of average work. Naturally, the cylinder walls are less affected, as the aluminum alloy is much softer than cast iron. The ring grooves did not show any wear, and only one piston-pin hole indicated a loose pin. The record of wear as a whole is at least as good as can be found for cast-iron pistons.

The disadvantage of the aluminum alloy pistons is its greater expansion, necessitating greater clearance, which must be determined very carefully as stated. It will be noticed that a motor equipped with aluminum alloy pistons has a light piston-slap during the first few explosions, but after the temperature of the pistons has risen they are as quiet as cast-iron pistons. The weight reduction has, of course, a quieting effect on the whole engine.

Commercial Features

Up to a short time ago aluminum alloy pistons were approximately twice as expensive as cast iron ones, due to the high cost of the alloy, and the waste in machining sand cast pistons, but even then the results with such pistons justified their use. Within the last few months American aluminum foundries have produced permanent mold or die cast pistons which of course not only save a great amount of waste in machining but also increase in general the tensile strength and uniformity of the material. The progress made in the development of aluminum alloys and their use assures the employment of aluminum alloy pistons in a great many motors in the near future.

E. S. Fretz, Light Mfg. & Foundry Co. gave three conditions for success with aluminum-alloy pistons. These are: first, engineering must take care of greater expansion and contraction; second, the mixture, and third, the foundry practice. Best results come from an aluminum with 4 to 6 per cent. magnesium content. In Europe, the usual practice

is to have an alloy composed of 90 per cent. aluminum, 7 per cent. copper and 3 per cent. zinc.

D. W. Sowers, Sowers Mfg. Co., asked regarding the effect of heat upon the tensile strength of the alloy and Mr. Gruenewald replied that tested bars chilled in sand molds and that these showed a tensile strength of from 24,000 to 25,000 pounds per square inch. However, he hopes to secure some test bars made in permanent molds, and therefore to get better results.

In regard to knocking, a point which was brought up due to the greater clearance necessary with such pistons, he contends that it is true that knocks will show up at low temperatures, but as soon as the pistons heat up, they expand sufficiently to eliminate knocks from this cause. They are consequently noisy during the first few explosions, which is one disadvantage, but it is offset by the many advantages.

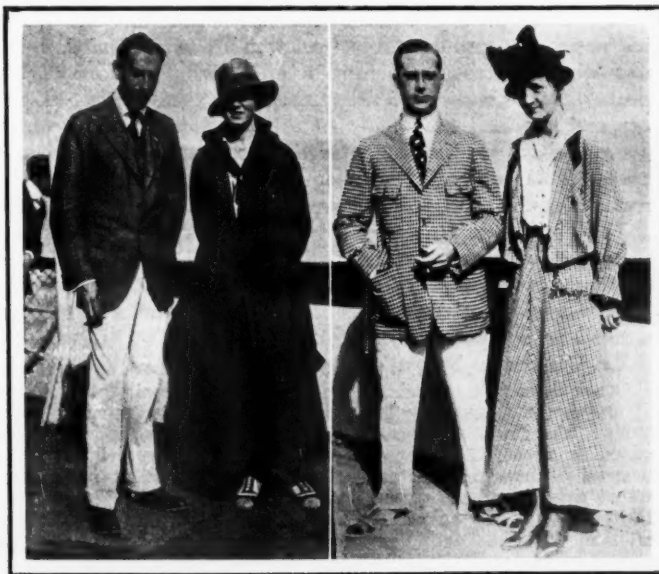
Ribs for Piston Heads

J. E. Diamond, Aluminum Castings Co., believes that all alloys deteriorate under high temperature as regards tensile strength. At temperatures from 1,800 to 1,900 degrees, the tensile strength ranges down to 12,000 to 13,000 pounds per square inch. In the conventional type of piston the head ought to be ribbed. When the diameter is under 3 inches, one rib is sufficient, but over this, cross ribs are advisable. The only way to arrive at the proper clearance, according to Mr. Diamond, is to cut and try and to forget about the standard clearances for cast iron. He knows of practically no case where aluminum-alloy piston seizure has hurt the cylinders, and it is also usually possible to repair the piston as well. He thinks the clearances, however, as set down by Mr. Gruenewald are about correct.

Permanent-Mold Piston Best

Mr. Diamond thinks it especially essential in high-speed engines to rib the head, and also that the permanent-mold piston, due to the chilling of the mold itself, increases the strength 25 per cent. over the sand-cast piston. This refers to aluminum alloys, of course.

Herbert Chase, of the A. C. A. asked if in using aluminum alloys any difference had to be made in ring clearances or in the ring design. Mr. Gruenewald said that the ring matter was not affected, and added that it was not necessary to make any change in the method of lubrication unless the slight slap at the start is objected to, in which case he recommended an oil of slightly higher viscosity, say around 300.



Winners of the dancing prize, John W. Watson, president American Bronze Co., and Miss Polly Souther and winners of second prize John R. Ide, salesman, New Departure Co., and Miss Marjorie Stewart



Group of members of the Society of Automobile Engineers' party on their cruise through the Thirty Thousand Islands of Georgian Bay

Weight and Speed Suspension Factors

Paper Presented By C. H. Gleason Produces Discussion Which Shows Variance of Opinion on Fundamentals of Design—Hard and Fast Rules Impossible

THAT we are still nowhere near a settlement of even a set of elemental principles of spring design was clearly brought out at the S. A. E. meeting in the paper on this topic given by C. H. Gleason, designing engineer, Kalamazoo Spring and Axle Co., and the discussion which followed.

The paper clearly pointed out that spring making is not an exact science and the use of the close limits of toleration, as used in other parts of chassis construction, are impossible. In his paper the author states that weight, load carried, speed and wheelbase are important details having to do with the proper determination of the suspension. The weight of the car and the load to be carried are the fundamentals which determine the proportions. Regarding speed, if the car is to travel at 35 to 45 miles per hour the front deflection must be reduced or the riding qualities will be poor.

The discussion hinged about the factors which determine the length of the spring and also got back to the much-mooted cantilever when the explanation of the lesser throw of this type was given as due to the fact that the deflection under static load is so great with this type.

Mr. Gleason in his paper says in part:

Other conditions having been met satisfactorily, the speed of the car will not affect the action of the rear springs seriously. The front springs, however, require thought where the speed is above the average. In a general way, where it is desired to have the front springs at their best at a greater speed than 35 to 45 m.p.h., the deflection must be reduced or the front of the car will be sloppy and hard to control. Reduction of deflection to the proper amount will improve the riding of the entire car. With the loads which are to be carried established, there is a suitable and proper deflection for the springs to take. To give them less deflection than is proper will make the car ride "crankily." This will become more apparent as the speed is increased, especially in the rear springs. Having found the happy medium, there will be no

Spring Points

Brought Out in Paper on Spring Design and Discussion Which Followed

*Gleason—Speed affects front spring deflection
Nothing is gained by using a narrow spring
Spring design determines front axle drop
Hess—Shock is produced by cumulative impacts
McMahon—Deflection, not load, determines reaction
Rumney—Section modulus is not altered by heat treating
Chassis frame rotates about the front axle*

room for argument as a compromise is the practical solution.

There is a wide difference in the action of the front and rear springs. The front spring, being the first to take the shock, has not only to meet it, but to carry the force of the entire load, driven by the power and momentum of the car. To do this successfully the deflection must be less than would otherwise be necessary. When the rear wheels strike the obstruction the load and the momentum are an aid to the spring itself.

The reaction of a spring is determined by its length and is approximately uniform. The shape of the spring has as much to do with its reaction as anything. With excessive camber the reaction will be sharpest, while a flat spring will be lazy by comparison. Friction between the plates, the type of spring and its proportions all have their effect. The amount of deflection will fix the time of the reaction, but the speed at which the spring moves will be fairly constant. If one had to consider only the reaction, designing a suspension would be easy; all cars could be treated much alike; first determining the ideal reaction, then the proper dimension of spring to get this result, the problem would be solved. But what is satisfactory when applied to one car may be disappointing when applied to another. If the spring is of the proper dimension for the car, and working at the proper deflection, the reaction need not be considered seriously. Its chief value lies, therefore, in determining the proper spring for the car.

A spring in action will deflect each way from the carrying point the same distance it has deflected from its normal position to that point, plus an additional amount for "slam" under extreme conditions. The cantilever spring seems to be an exception to this rule, in that it almost never takes any slam.

The other types of spring will take a slam in greater or less degree according to their type; the half elliptic the least, the platform slightly more, the three-quarter elliptic still more, and the elliptic the largest amount. It will thus be seen that for a given deflection a car can be hung lower on cantilever springs than on any other type. With other types additional clearance must be provided according to their characteristics.

A spring is at its best when it is horizontal and the master plate is straight. It will take the shocks of the road better, will be found steadier, its action will be lazier, and the car will pitch less. My experience is that it will have slightly greater capacity when being deflected beyond a straight line than when deflected to that line.

Nothing is gained by using a narrow spring. Within reasonable limits the wider the spring the more steadily and more satisfactorily the car will take the road. Piling up the number of plates to get the required capacity is expensive. A spring of this type seldom maintains the full capacity of each individual plate. A simple rule can be depended upon to give good results. Where the spring is thicker at the thickest point than it is wide, it is desirable as well as economical to increase the width and reduce the thickness.

It is essential for best results to maintain a proportional deflection between the front and rear springs. If the deflection of the front spring is proportionally too great, it will affect adversely the riding of the whole car. If the deflection of the front spring is proportionally too small, while the effect will not be so noticeable as in the other case, the suspension as a whole will not measure up to what one has a right to expect. As between the two extremes, however, it will be found better to hold the spring below the ideal deflection rather than above. This will be especially true if any considerable speed is to be made. As the weight it is to carry determines the proper deflection of the rear spring, and the deflection of the front spring should be determined from the deflection of the rear spring, the rear suspension should be laid out first. Having reached this far, the rest will be easy.

It may not be out of place to call attention to a common practice. The spring suspension is seldom considered before the axle and the frame have been selected. While it is possible to make a spring that will fit into almost any place within reason, it often happens that to do so means reducing its efficiency, and added cost which could have been avoided easily if the spring had been considered first. What is desirable in the way of drop of the front axle and the shape of frame is determined from the spring. A slight modification for the purpose of improving the suspension is usually entirely feasible if considered in time. What might appear to be very minor changes in either the openings or dimensions may mark the difference between an excellent suspension on the one hand and an ordinary or indifferent one on the other.

Before the general discussion of Mr. Gleason's paper on spring design was opened, Henry Hess, president of the Hess Steel Co., was given an opportunity to speak regarding some new spring designs which he has found to be very practical. They are not theories, he said, but actual tried-out constructions. He has long been investigating spring design and has had ideals of what a spring should be, gained through experience as a rider in cars. The desirable things in a spring in Mr. Hess' mind are that it should be exceedingly responsive to very small shock, and that it have the maximum amount of allowable deflection under load. It should



Party of S. A. E. cruisers ashore exploring the interesting country

have the maximum length at maximum load and minimum length at zero load.

The main point Mr. Hess sought to establish was that a spring should be designed to produce no shock. Shock, he explained, is due to a second vibration coming on at the apex of the previous wave, thereby having a cumulative effect. That spring is best which has such a characteristic that there is only a single vibration. In Mr. Hess' opinion, the cantilever comes closest to the ideal in this respect.

Mr. Hess had a model apparatus with a rotating element fitted with blocks to give the unevenness of a road surface. On this a wheel revolved and a lever connected to it represented the chassis. Pointer connection with this part gave a means of tracing on a drum one curve showing the motion of the axle and another tracing the action of the spring. This apparatus is used to show the results attained with various types of spring, models of them to proper scale being used.

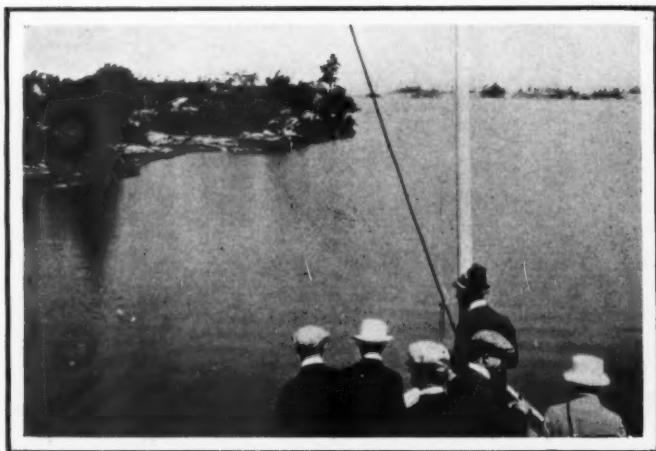
Mr. Hess showed two new forms of springs, one known as the Schwarz and the other he calls the cam single-leaf type. In comparing these designs with other more conventional forms, he stated that for a similar carrying capacity and action, the Schwarz saves 20 per cent. on either heavy cars or light ones, while the single-leaf is lighter in a ratio of 3 to 1.

Deflection Determines Reaction

In the general spring discussion following the paper and Mr. Hess' talk, there was considerable divergence of opinion among those taking part, and it is evident that interest in springs is not waning.

H. R. McMahon, Standard Steel Spring Co., wrote in criticism of the paper, saying that while it is entitled spring design, he could see no aids in that direction in it. He took exception to one statement to the effect that the reaction is determined by the load placed upon the spring. He thinks that reaction is determined by the deflection and not by the load. The reason advanced for the less throw of the load with a cantilever spring is that the deflection under static load is usually 100 to 150 per cent. greater than with other types.

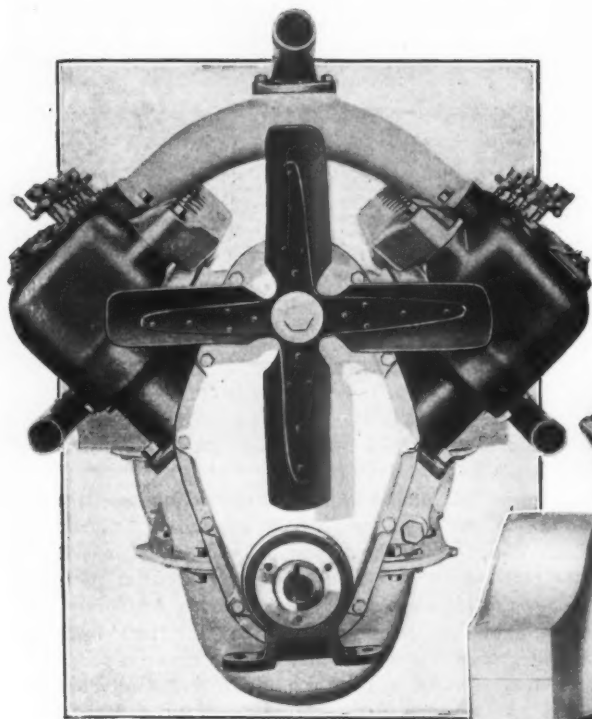
M. J. Rumney, manager Detroit Steel Products Co., does not think that the capacity of a spring varies with its heat treatment. The modulus of the section is unaffected by the treatment. As regards the position of the axle clips he regards the rear end of a chassis as pivoting about the front axle and that the rear end of the frame rises and falls in an arc of a circle having the front axle for its center. This being the case the axle clip should be forward of the center in proportion to the wheelbase of the car.



Looking over the bow of the vessel on the cruise through the lakes

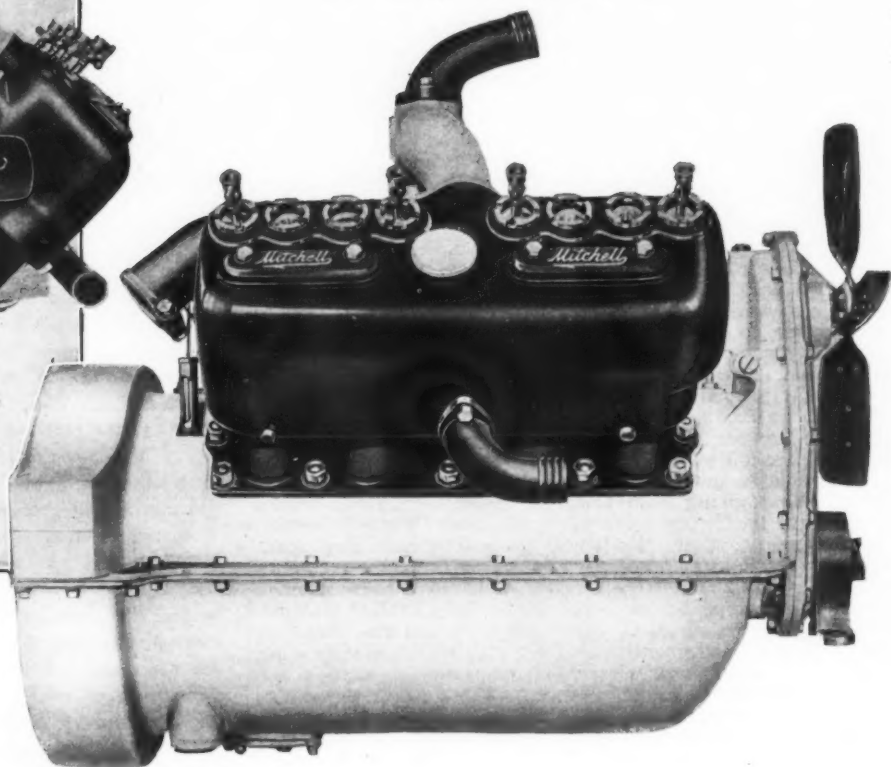
Mitchell Brings Out Eight and Six

3 by 5 1-8 Eight Motor Fits into Chassis
with Little Change—Six Motor
Is Only 3 1-2 by 5



Above—End view of V motor used in the eight-cylinder Mitchell for 1916

Right—Right side of motor which is slightly over 33 inches in length and 22 3-4 inches wide



FOR 1916 the Mitchell-Lewis Motor Co., Racine, Wis., has brought out an eight-cylinder model selling at \$1,450 in two or five-passenger form and also a six-cylinder car—the Six of 16—marking the invasion of the field of lighter and lower-priced sixes. As reported in *THE AUTOMOBILE* for June 3, the new six sells for \$1,250, or \$335 less than the lowest-priced Mitchell six of 1915, and the same price as the 1915 four. The eight-cylinder model shows nothing foreign to former design insofar as the body and running gear are concerned, the new motor fitting into the chassis with but little change.

The Eight-Cylinder

Taking up the eight-cylinder model, the 3 by 5 1-8-inch engine consists of two blocks of four cylinders each set at 90 degrees in a staggered position. The crankshaft is a three-bearing construction with side by side connecting-rods and cooling is by thermo-syphon. The clutch is a stamp steel cone while the remainder of the transmission system is made up of three-speed amidships gearset, a single-universal propeller shaft and floating rear axle. A Westinghouse cranking, lighting and ignition system is used. Wheelbase of the car is 116 inches and it is fitted with 34 by 4-inch tires, non-skid in the rear.

In adopting the eight-cylinder motor, the Mitchell company has not changed the hood length because the overall length of the motor is slightly over 33 inches. The width is 22 3-4 inches. In the Mitchell motor the cylinder blocks are bolted to an aluminum crankcase which is split horizontally into

two parts, the lower serving as an oil pan and the upper as the crankshaft support. The top of the crankcase between the cylinder blocks is provided with a removal plate which gives access to the camshaft, which lies directly above the crankshaft. Also between the cylinder blocks is the carburetor which feeds by side outlets through a hot-water jacketed manifold. The exhaust manifolds also are in the V and are bolted to the cylinder castings.

Valves Are Large

The L-head cylinders have extended base flanges which carry the push rod operated by an internal camshaft with eight cams, each one operating two opposite rods. The valve mechanism is inclosed by cover plates and provision is made for oiling these parts by means of oil vapor from the crankcase. The valves are 1 11-16 inch in diameter and have a clear opening of 1 1-2 inch which is one-half the cylinder bore. The use of these comparatively large valves perhaps is contributory to the high power development claimed for this motor.

A feature of simplicity of the motor is the use of but three timing gears. The timing set is composed of a gear on the crankshaft, one on the camshaft and one on the generator shaft. These cars run in a bath of oil supplied by a feed from the oil pump and are readily accessible on removal of the front cover plate.

In order to lighten the pistons and at the same time to prevent smoking of the motor, the pistons have drilled skirts which permits the excess oil to drain back into the crankcase.

The cooling water is made to pass entirely around each cylinder and around the valve seats. Baffles are used so that the water, as it enters the jacket, is discharged against the interior of the valve seats. There are large inlet and outlet passages the former being in the center of each block. The outlet is by means of the jacketed inlet manifold so that there is but one passage to the radiator. Cooling is assisted by a four-blade fan, gear-operated from the front end.

In the lubrication, oil is forced from a reservoir in the crankcase to the main bearings, by means of direct leads and the crankshaft is drilled so that a portion of the oil makes its way to the rod bearings and the excess which drops from the rods is used for cylinder and piston oiling. The timing gears and camshaft are fed by direct leads. Each cylinder block has a breather opening between the second and third cylinders.

The carbureter, which is a Rayfield, is fed from a Stewart vacuum tank and ignition is by the Westinghouse interrupter and distributor mounted on the generator which is driven directly from the crankshaft.

The motor is suspended at three points, the two at the rear being formed by extensions of the crankcase. Immediately behind is a universal. The clutch is a cone type with visible spring adjustments and drives a three-speed gearset which uses a square shaft for the sliding pinion. The front end of the main shaft is mounted on a roller bearing and the rear end on a ball type with the countershaft operating on roller bearings.

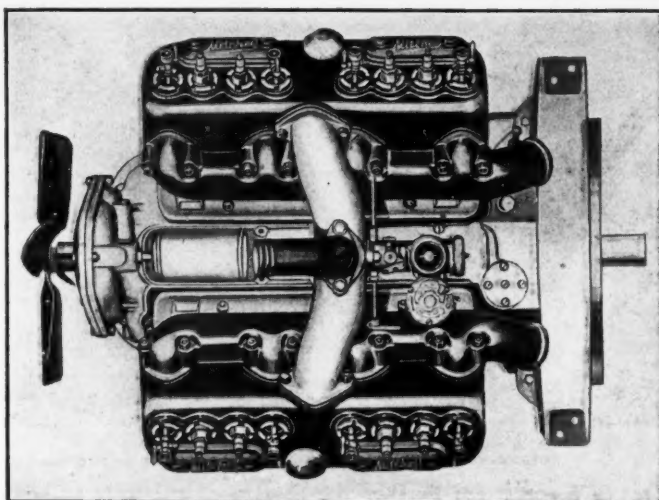
Driveshaft in Torque Tube

The drive from the gearset is by a shaft inclosed in a torsion tube, a construction which is not new to Mitchell cars. The rear axle is a floating design with straight bevel gears affording a ratio of 4 to 1. The differential and wheel bearings are rollers.

Spring suspension in the eight differs from that in the new six-cylinder car in that, instead of the cantilever springs used on the six, three-quarter elliptic rear springs are fitted. In order to lower the center of gravity and thus minimize skidding, the springs are slung under the axle. The brakes are external and internal and operate on 14 by 2 inch drums.

In the steering mechanism an item of easy maintenance is offered by the use of a full gear instead of a sector in combination with the worm. This provides four positions of the gear and thus affords four renewals of the wearing services.

The characteristic wedge shaped frame of channel section with exceptionally wide gussets is continued in the eight



Plan view of motor used in the Mitchell eight

giving a somewhat heavier frame than the lattice work construction employed in the new six.

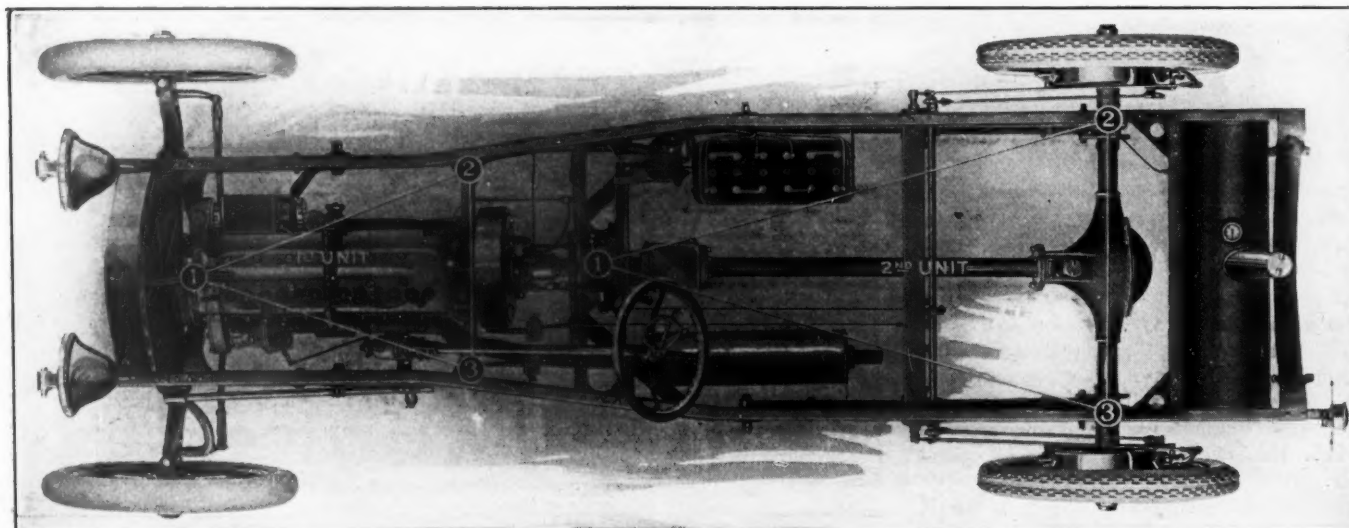
Turning to the new six, the engine is smaller than the smallest 1915 six from the Racine factory, being 3 1-2 by 5 inches against 4 by 5 1-2 for 1915. Wheelbase is 125 inches which is 2 3-4 inches less than the 1915 six and the car is appreciably lighter than its predecessor.

Nevertheless the Six of 16 is not a little six in any sense of the word unless it be perhaps in the matter of fuel economy and ease of handling. An hour at the wheel of the new car sufficed to show that in the matter of power and getaway the smaller motor left nothing to be desired.

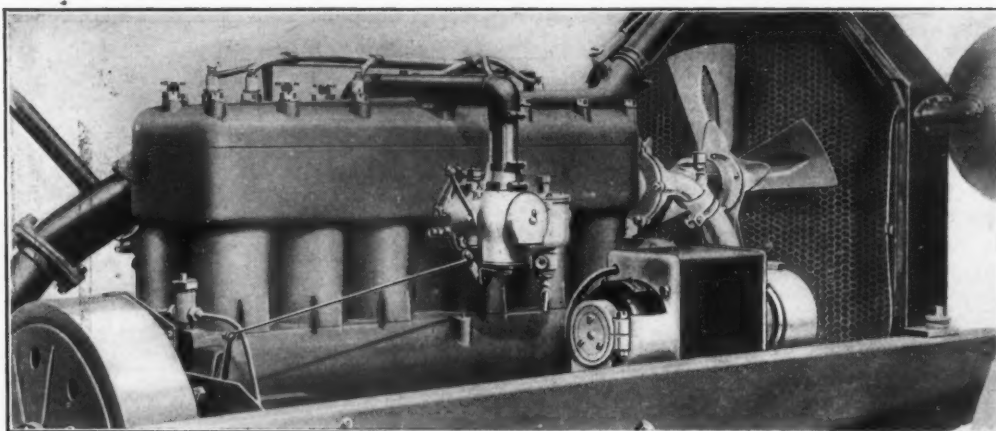
There is one feature of Engineer Bates' new design which is worthy of special mention and this is the vastly improved riding quality. Whether or not this can be credited chiefly to the new design of cantilever rear springs or to the general balance of the car as a whole, has not been determined. In any event, there is a noticeable lack of throw.

Accessibility a Feature

A striking improvement is extreme accessibility of all parts of the chassis. The designer has gone a step beyond anyone else in the field in making the whole chassis completely get-atable from above with the touring car body in place. This is accomplished by arranging for the very quick and easy removal of the floorboard—a point which could be well improved



Plan of Mitchell six chassis, with the double three-point system of suspension. The same system is used on the eight. Note the strong cross member which forms the forward support of the second unit



Intake side of Mitchell six motor showing carbureter and motor-generator mounting

in many designs, but further the portion of the body under the seats consists of simply a lattice work, which can be lifted out when the seat is removed, thus exposing the entire chassis back of the dash with the exception of the strips immediately below the forward part of the seat frame and the seat back. To provide space for the tools, which in conventional designs are carried under the front seat, a steel tool box is fitted under the hood, between the frame and the left side of the motor, so that all the tools needed for work on the motor are normally at hand. Unusually ample pocket space is provided in the doors, so that smaller tools and fitments may be carried there. The Jiffy curtains are taken care of by having them roll back across the rear of the top. The battery which is carried within the frame, just back of the dash, is accessible by removing the forward floorboard.

Car 400 Pounds Lighter

A rather surprising reduction of weight, amounting to some 400 pounds, has been accomplished by cutting down the mass of a number of units by better design without decreasing their strength. For instance, the somewhat massive frame construction which has characterized Mitchell cars recently, has been greatly lightened.

The 3 1-2 by 5 motor is a high-speed type and with this end in view, special efforts have been taken as to balancing and lightening the reciprocating parts. The pistons are drilled to decrease weight and are provided with rings in the two lower grooves which are made up of four steel rings to eliminate loss of compression. The top ring is of the conventional iron construction. Small holes drilled through the machine oil grooves around the piston allow the surplus oil to flow back into the crankcase.

Cylinders are L-head, block cast and integral with the crankcase, to give rigidity to the motor and reduce the vibration. The cylinder head is a one-piece casting secured by three rows of bolts and a leak-proof fit is assured by the use of a one-piece, copper-asbestos gasket. The cylinder heads can be removed without disturbing any other part of the engine. The crankcase, a barrel type, having the lower half formed by a light, seamless, steel stamping, divided into two compartments, the upper fitted with overflow openings, and troughed for the connecting-rod spoons, the lower comprising the oil reservoir.

The three-bearing crankshaft is offset 1-2 inch from the center of the cylinders. The gears which drive the camshaft and distributor and tire pump are inclosed in

a housing which is a part of the crankcase. Gears are lubricated by a separate oil lead and have helical teeth. The lubrication is a combination of circulating and splash, the circulation being maintained by a plunger pump operated by camshaft eccentric. A small quantity of oil is carried to the clutch bearing. A unique idea is carried out in the oil indicator. In place of the usual sight feed on the dash a plunger type operated by the oil pressure is used consisting of a small

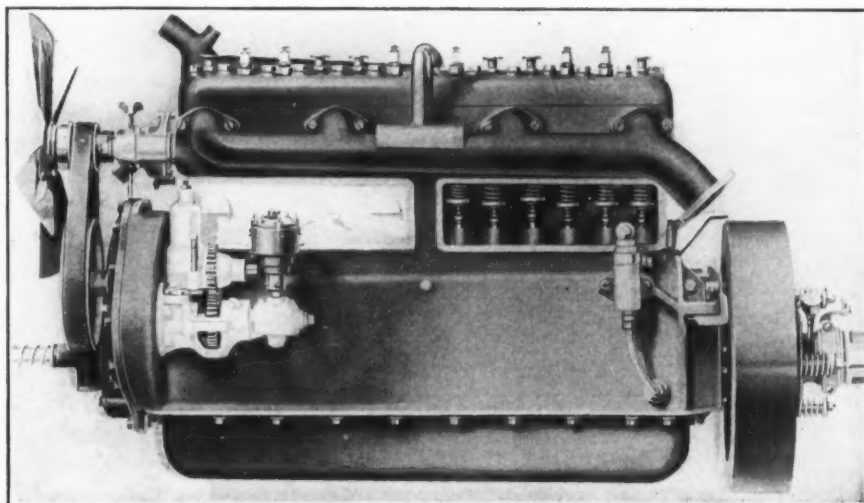
rod protruding from the dash, proportionately to the pressure of the oil in circulation. In addition an oil lever indicator is provided on the crankcase. Push rods and valve stems are supplied with an oil vapor through breather openings into the crankcase.

Another unusual bit of design is in the combination of fan and water pump. At the front of the motor, instead of mounting the centrifugal pump on a layshaft, it is mounted on the fan shaft where it is driven by the endless fabric fan belt. Adjustment is provided by a wing nut which swings the entire fan and pump assembly. The integral fan and pump brackets also forms the outlet for the water pump, thus simplifying the construction to a point where only one hose connection to the pump is necessary. The waterjackets have been extended down so that they have extra capacity around the exhaust valve seats.

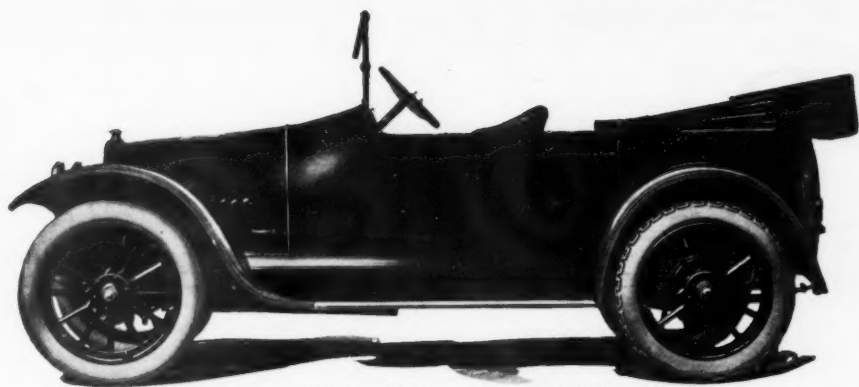
Ignition is by storage battery with an automatic circuit breaker and distributor of the single-unit type driven through worm gear from the timing gears of the motor. The high-tension wires to the plugs are carried by a special supporting bracket which prevents chafing and leaking.

Stewart Vacuum Fuel Feed

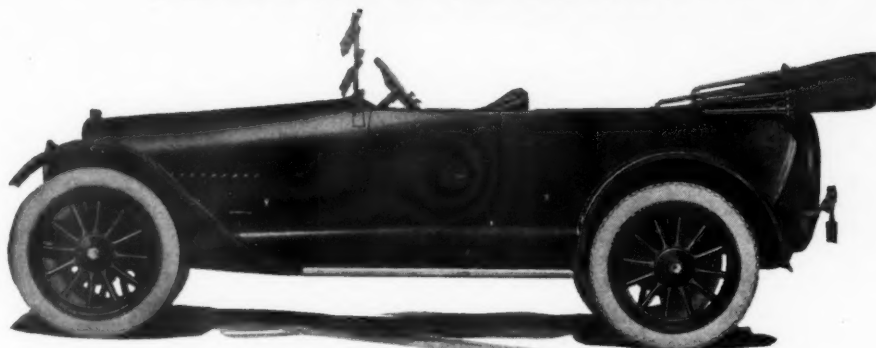
The Rayfield carbureter is on the right and the intake manifold is cast inside of the cylinders, and passes between the middle cylinders from the carbureter on one side to the valves on the other. Fuel is supplied from a tank at the rear by the Stewart vacuum system. Within the flywheel is a cone clutch comprising a stamped steel spider faced with chrome leather, and having auxiliary springs. Adjustment



Exhaust and valve side of Mitchell six motor with one cover plate removed and showing mounting of ignition distributor. Note hot air intake for carbureter passing over cylinder block



Mitchell eight-cylinder touring car which lists at \$1,450



Mitchell six—the Six of 16—which sells for \$1,250

is by three adjusting nuts, which provide correct engagement.

The electric system comprises a combined motor-generator driven by silent chain at the front end of the motor.

The three-speed gearset, considerably improved, has been decreased in both size and weight without decreasing either the size or strength of the gears and shafts. Instead of a jaw clutch on direct as in earlier designs, an internal gear coupling is employed and the shafts are otherwise shortened so that the gearbox is 4 inches shorter than in the 1915 car. At the same time the throw of the lever has been shortened and the latter is set well to the front so that it does not interfere with entering or leaving the forward compartment. The power transmission system is called by the Mitchell people the two-unit, three-point suspension, one unit being the engine and clutch, and the other, the gearset and rear axle. Between the clutch and gearset is interposed a universal, and the gearbox is mounted on the front end of the torsion tube and supported by trunnions from the main cross member of the frame.

Propeller Shaft Is Hollow

Another method by which excess weight has been eliminated without sacrificing strength is in the propeller shaft. It is hollow and of chrome-vanadium steel. Final drive is by pinion and gear and a special feature is a bearing behind the driving pinion. The gear ratio is 4.07 to 1 on direct. The floating axle drive shafts have splined shafts, the load being carried on steel tubes riveted to the malleable center housing. Roller bearings are provided throughout.

Brakes are internal expanding and external contracting. The brake cross shafts are hollow to cut down weight. The drums are 14 inches in diameter and turnbuckle adjusters located conveniently permit of taking up any wear.

Cantilevers Cleverly Mounted

It is in the springing that there has been a particular achievement. The cantilever rear springs are mounted directly under the frame side members and attach to the seats by double spring bolts, spring seats turning on the axle housing. The forward ends fasten to the side frame by

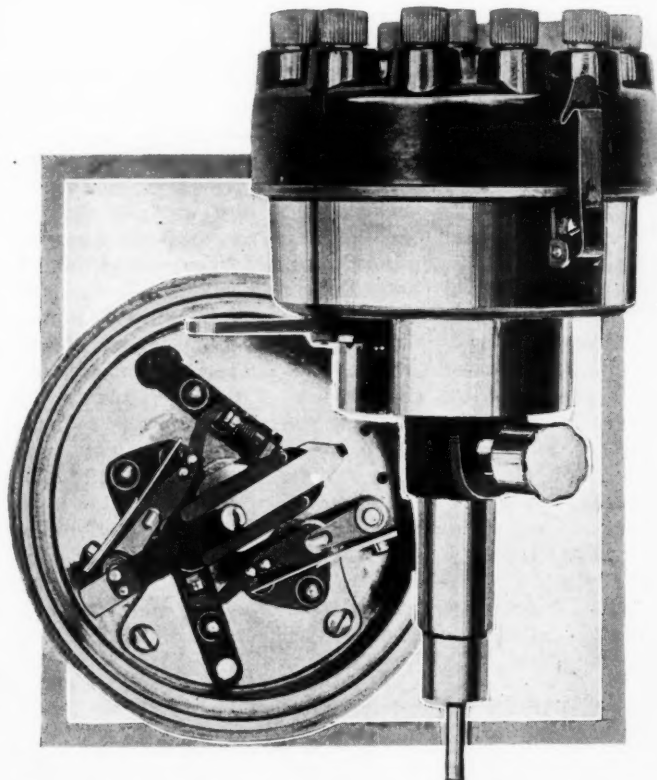
shackles allowing free play for the spring action. Bushings are provided for the eye bolts.

Mitchell bodies for 1916 are of the smooth, boatline type as may be seen from the accompanying illustration. A feature is the mounting of the headlights directly on the sides of the radiator. Instrument board equipment includes a priming device, 60-mile speedometer, oil gauge, lighting and ignition switches, horn button and instrument board lamp, the latter being provided with an extension cord permitting it to be used as a portable inspection light. Both six and eight are fitted with 34 by 4 tires, non-skid in the rear, on demountable rims, with one spare rim.

Headlight dimmers are provided by a series parallel arrangement of the lamps designed to meet requirements for both city and country driving. Other equipment includes windshield, one-man top, power tire pump, quick-acting side curtains, robe rail and foot rail.

Remy Ignition for Twelves

In order to provide positive ignition for twelve cylinder motors, the Remy Electric Co., has brought out a timer-distributor unit which has two breaker boxes in one, operated by a single hexagonal cam as illustrated below.



Exterior view of the new battery ignition system for twelve-cylinder cars manufactured by the Remy Electric Co., Anderson, Ind., together with a view of the breaker box. Instead of using a cam with the same number of points as sparks required, a hexagonal cam is used and the twelve sparks are obtained by fitting two breakers, one on either side of it. Either manual or automatic spark advance or both are possible with this distributor

Inquiries

¶ The purpose of the Rostrum department is primarily to aid in the solving of motorists' problems. Readers of THE AUTOMOBILE are requested to allow our editorial staff aid in the solution of difficulties as they arise and perhaps through this assistance reduce the cost of upkeep of their cars and gain a useful knowledge in the economical phases of the vehicles.

The Rostrum

Radiators Not Designed by Formulae

EDITOR THE AUTOMOBILE:—Can you refer us to any information, either in book form or in the columns of THE AUTOMOBILE, dealing with the design of automobile radiators and cooling fans?

What we want is something which will answer the question of radiator area required for a 4-inch bore, 5 1-2-inch stroke, and the motor running at a speed of 800 r.p.m.

2—What is the most efficient angle of the fan blade?

N. Y. C.

F. E. ROGERS.

—The size of the radiator cannot be calculated exactly by formulae as there are so many conditions which enter into the problem that it cannot really be reduced to any definite standpoint and therefore has always been solved by a trial-and-error process. It may be taken as a general rule, however, that one-third of the heat units in the gasoline consumed in the cylinder is given off through the cooling water. If, for instance, a quantity of fuel containing 15,000 B.t.u. were consumed in the cylinder in a unit of time then the radiator would probably have to handle a sufficient quantity of water to remove 5,000 B.t.u. in the same length of time from the waterjacket.

Measured in B.t.u.

The cooling effect of a certain quantity of water is directly measured in B.t.u. and, roughly, may be stated as follows: If a given weight of water, W , in pounds passes through the radiator in 1 minute, and the difference in temperature between the water as it enters and as it leaves the radiator is T , the number of B.t.u. given up by that water is equal to WT . It will be thus seen that there are two variables, the weight of the water passing through the system and the difference in temperature on entering and leaving. The amount of water will depend upon the capacity of the radiator in the first place and the capacity of the pump, or circulating medium, in the second place. The temperature in and out, will depend upon the arrangement of the cooling area, the amount of exposed surface, the conductivity of the radiator metal, the difference in temperature between the water and the exterior air, the efficiency of the fan and a multitude of other less important factors. Therefore, considering the large number of variables which enter into the problem of radiator design, it will be seen that the most economical method of handling the problem is to place a radiator on the car that will handle the water safely under the worst possible conditions of high atmospheric temperature and extended low gear travel.

Theoretical Blade Angle Impractical

2—There is no such thing as the most efficient angle of a fan blade, every different speed of the car, every different variation of the velocity of the wind or the speed of the motor and diameter of the fan itself, would make the theoretical pitch undergo wide changes. As stated by one authority, it is impossible to give any general rules or formulae covering the proportions of parts of fans and blowers. There are no less than fourteen variables involved in the con-

struction and operation of a fan, a slight change in one producing wide variations in the performance. Therefore the design of a new fan is largely a matter of experimentation until a compromise design is finally reached.

Preventing Noise in Oldham Coupling

Editor THE AUTOMOBILE:—I am running a Buick model 16 and the coupling between the clutch and transmission is very noisy. Could you tell me of a coupling which I could use here to eliminate this and what it would cost?

Lawrence, Mass.

C. E. C.

—The clutch to transmission couplings on the model 16 Buick consists of an Oldham coupling ring inserted between the clutch sleeve and the forward end of the gear square shaft. This coupling is made in three pieces; including the sleeve, ring and a square male piece which fitted over the forward end of the clutch gear. There are therefore two places where wear can occur and result in noisy action: First, at the lugs of the Oldham ring and second, on the square sides of the male coupling. You should look at both these points and measure the clearance. If the clearance is too great new pieces should be secured to fit.

Clincher and Q. D. Tires Are Same Size

Editor THE AUTOMOBILE:—What is the difference in size of tires of the clincher and clincher Q. D. types, or why is it that a clincher tire will not fit the same rim that a clincher Q. D. of a given size will fit?

2—What is the proper way to align the wheels of an automobile?

3—What are the proper positions in angular measurement relative to the centers for the opening and closing of the inlet and exhaust valves of the eight-cylinder V-type engine?

4—How may one determine the position of the armature of a magneto at which the contact breaker in the primary should open to give the spark of greatest intensity?

Ancon, C. Z.

ALLEN EDWARDS.

—The difference between the clincher and the Q. D. clincher type is not one of size, but rather of bead construction. The bead of the regulation clincher tire is soft and made to stretch over the rim, whereas, in the Q. D. design, the bead does not have to stretch over the rim, and hence can be made stiffer.

2—The proper method to align the wheels of an automobile is shown in the accompanying illustrations, Fig. 1. At the same distance above the ground as the center of the hub, the measurement is taken across the width of the spread of the two front wheels from the inner side of the rims of each. When this measurement has been carefully checked the wheels are rotated to different positions and measurements taken at the same height. They should always be the same. When the wheels have been found to be true, as far as this measurement is concerned, similar measurements are made at the rear of the wheel. The distance across the wheels at the rear will be slightly larger than in front on account of the toe-in generally allowed. This amounts to 1-4 inch as a rule.

Communications

¶ The editor of the Rostrum is anxious to secure from car users and others, communications dealing with the overcoming of difficulties in making repairs and in the numberless other phases of every-day automobil- ing. This department is mutual and is a common ground upon which an interchange of ideas and opinions can be made as freely as in the clubroom.

3—The valve timings of all the eight-cylinder engines differ, no stated rule being followed. An example, however, may be given in the case of the Cadillac eight, the timing of this motor being as follows: Inlet opens at top center and closes 46 degrees 40 minutes past lower center, exhaust opens 46 degrees 40 minutes before lower center and closes at top center.

4—All the magneto manufacturers have instruction books covering their own type which give specific directions as to how the armature setting should be made. Before specific directions can be given, the make and model of the magneto must be known.

Either Gasoline or Gasolene Is Correct

Editor THE AUTOMOBILE:—Why is there a difference in the spelling of the word gasoline? We have seen it spelled gasoline and gasolene. Which is correct?

Lake Mills, Wis.

A. C.

—Either gasoline or gasolene is correct. The suffix ine, means pertaining to, while chemists have more or less agreed upon the use of ene, as a substitute for ane in speaking of members of the hydro-carbon series. Hence, while the spelling among chemists may be ene, and among others, ine, they are perfectly interchangeable and either is correct.

Carburetor Needs Adjustment in Summer

Editor THE AUTOMOBILE:—I have a 1914 Coey Junior engine, four-cylinder 2 3-4 by 4, with a 7-8-inch Mayer carburetor and am experiencing much trouble with same. I received this car in the winter and the engine worked all right. It has no hot air connection to the carburetor and as soon as the warm weather arrived I began to have trouble, making it necessary to frequently adjust the carburetor.

The engine will work well sometimes, but after closing the throttle and reducing the speed to 10 or 12 miles, on reopening the throttle the engine will miss and fire badly, and very often I must change the gears to keep from stopping entirely. Frequently it is very difficult for me to start the engine without making adjustments on carburetor. The float allows the tube to be just full without flooding. There are no air leaks between carburetor and cylinders.

Derry, Pa.

A. S. AGEY.

—You can probably cure this trouble by taking the bottom part of the carburetor off and putting a little more tension on or reducing some the tension on the spring. This is accomplished by pressing the spring between the thumb or removing part of a coil or all of one coil from it. It is impossible to say just what condition you have to deal with but it is

quite certain that the adjustment can be obtained by manipulating the spring one way or the other by giving it more tension or less tension.

Can Fit Magneto to Rambler

Editor THE AUTOMOBILE:—Please advise me if a Splitdorf model D magneto or Remy model S, Model T or R L magneto is suitable for a model 44 serial number 20,277 40-horsepower Rambler.

Norfolk, Va.

GEO. SMITH.

—The Splitdorf model D magneto or any other of the four-cylinder types will fire this car. On the Remy the model S would be the most suitable, as we believe it could be installed without any special fitting. The model T and R L however, would be very suitable for this car but you would have to have fittings made to accommodate their installation.

Timing of the Maxwell Mercury Model

Editor THE AUTOMOBILE:—Kindly give me the following information on the 1914 Maxwell Mercury roadster:

- 1—Timing in degrees of the inlet and exhaust valves.
- 2—Gear ratio on high.
- 3—Explanation of the oiling system.
- 4—The bore and stroke.

5—Would it be possible for me to get an instruction book on this car?

6—Was this car tuned for speed and how fast should it be when in perfect shape?

Poughkeepsie, N. Y.

LLOYD C. DECKER.

—1—The motor is timed as follows: Inlet opens 15 degrees past upper dead center and closes 40 degrees past lower dead center. Exhaust opens 40 degrees before lower center and closes 10 degrees after top center. See Fig. 2.

2—The ratio of this car on high gear is 3.5 to 1. This is on direct drive.

3—The oiling system is a splash design, the oil being kept to a definite level by a standpipe in the center of the crankcase. The pump takes the oil from there and returns it to the tank. The same pump takes the oil from the tank through the sight feed oiler and by gravity it runs from there to the front of the crankcase and finds its level in the standpipe. This pump does not oil the clutch compartment and it is necessary to put oil in the clutch compartment from time to time. The disks in the friction clutch should run in a bath of oil to the depth of 3-4 inch, which will be sufficient to lubricate all parts of the clutch compartment.

4—The bore of this motor is 4.25 inches and the stroke also 4.25.

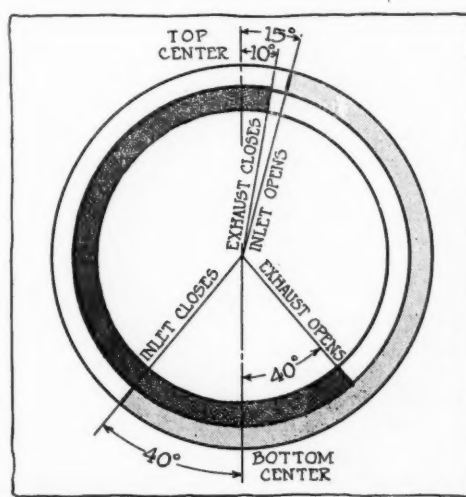
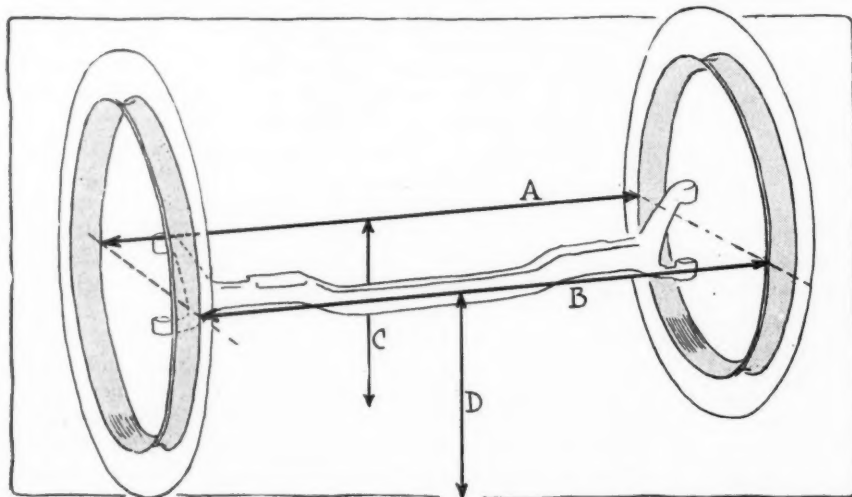


Fig. 1—Left—Diagram illustrating the proper way to align the front wheels to obtain correct steering and prevent side wear on the tires. Fig. 2—Right—Valve timing diagram of the Maxwell Mercury

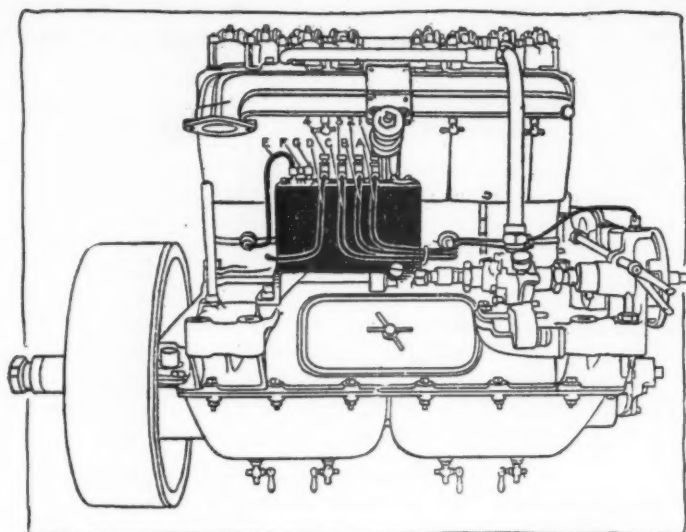


Fig. 3—Lubrication system on the 1909 Pope-Hartford, showing oil lead connections

5—The Maxwell Motor Sales Co., Newcastle, Ind., is forwarding an instruction book direct.

6—This car was tuned for speed and with a Stromberg carbureter using a sharp nozzle will develop 60 miles an hour when in perfect condition.

Lubrication of Old Model Pope-Hartford

Editor THE AUTOMOBILE:—I have a Pope-Hartford 1907 or 1909 model which gets too much oil in cylinders 2 and 3. Can you publish illustrations of the oiling systems of these two models and suggest to me how to remedy the trouble?

Wheaton, Minn.

O. H. B.

—Since these cars were made an improved oiling system has been installed in these models. This is a matter entirely pertaining to the pistons, and the Hartford Motor Car Co., which is handling the parts and repairs for this car, states that if the pistons were forwarded to them they could be machined to the latest design at a cost of \$5 for a set of four, transportation charges additional. This work can be done and pistons returned within 24 hours after receipt of same. It may be possible on account of the service that these models have seen, that the cylinders are worn. They could be reground and special pistons and rings made which would eliminate the trouble you are experiencing, although of course this is an expensive proposition. The cost of reboring of cylinders, making new pistons and rings would be \$50 for each car provided that they are four-cylinder cars. It would require about one week for this work.

The method of lubrication on these cars is as follows: In the model L, 1907, a seven-feed sight-feed mechanical pump oiler operated by a belt driven from the camshaft provides lubrication for the cylinders and main engine bearings, camshaft front bearing and crankcase; the pipe leading to the crankcase should not be depended upon for the total supply of oil for crankcase. It is important that the oiler be adjusted to feed so that one drop only at a time will show in the sight feeds A, B, C, D, E, F and G, to each cylinder and bearing except the center bearing which should be wide open.

The supply is regulated by screws on top of the oiler; by screwing them down you decrease the supply, and by screwing them up you increase it. The sight feed on the dash will show the quantity of oil being supplied to each tube.

The main crankshaft is lubricated at both front and rear bearings by feeds from the mechanical oiler and in addition by splash, suitable ribs being cast on the inside of both ends of crankcase for this purpose. The center bearing is also lubricated by splash taking the drainage from both sides of

the partition in the crankcase. The camshaft has three bearings all inclosed within the crankcase. The front bearing is lubricated from the oil pump, while the center and rear bearings are lubricated entirely by splash, suitable oil pockets, holes and grooves being provided for this purpose.

Oiling the Wristpin

The wristpin has its bearing in the piston itself and is lubricated from an annular groove cut in the piston just above the hole made for the wristpin and has suitable holes leading to the grooves cut on the inside of the bearing which distributes the oil their entire length. When the piston reaches the bottom of its stroke this groove uncovers a corresponding groove in the wall of the cylinder which is supplied with oil from the oil pump and, as the entire wall of the cylinder is also covered with oil from the splash from the crankcase, perfect lubrication of the wristpin is assured.

The lower cover to the crankcase, which is merely an oil-pan, is arranged in two compartments, one for each pair of cylinders, each compartment being sub-divided by a rib which stands about 1-8 inch higher than the oil level to be maintained in the crankcase, each compartment of which should contain about 1 pint of oil. This arrangement prevents the trouble so often experienced by flooding either the front or the rear cylinder in ascending and descending hills and necessitating frequent cleaning of the spark plugs.

The camshaft, magneto and pump gears are inclosed in a separate case attached to the front of the crankcase and are packed with a special grease, a can of which is supplied with each car. These gears should be repacked about every 500 miles. This can be accomplished by taking off the cap at the left of the case, remove pump gear, then force in as much lubricant as possible.

On the model S, 1909, there is a five-feed sight-feed mechanical pump oiler, Fig. 3, shaft driven from the pump-shaft provides lubrication for cylinders and front gears. These pipes should not be depended upon for the total supply of oil for the crankcase. It is important that the oiler be adjusted to feed so that one drop only at a time will show in sight feeds to each cylinder and three drops to front gearcase.

Micrometer Adjustments Regulate Supply

The supply is regulated by micrometer adjustments which are located on the top of the oiler as per Fig. 3. A regulates oil supply to the gearcase. B regulates oil supply to cylinder 1; C regulates oil supply to cylinder 2; D regulates oil supply to cylinder 3; E regulates oil supply to cylinder 4 and sight feed on dash. By screwing to the right you increase the supply. The sight feed on the dash will show that the oiler is working and also show the amount of oil being supplied into fourth cylinder. Individual sight feeds are on top of the oiler. By pressing down on bleeder No. 1 the amount of oil entering front gearcase will be shown in sight feed. Bleeder 2, the amount of oil being supplied front or No. 1 cylinder. Bleeder 3, the amount of oil to cylinder 2 and bleeder 4 the No. 3 cylinder.

The main crankshaft bearings are lubricated by splash, suitable pockets being cast on the inside of both ends and center of crankcase for this purpose. The camshaft has three bearings all inclosed within the crankcase which are lubricated entirely by splash, suitable oil pockets, holes and grooves being provided for this purpose.

The wristpin has its bearing in the piston itself and is lubricated from an annular groove cut in the piston just above the hole made for the wristpin and has suitable holes leading to the grooves cut on the inside of the bearing which distributes the oil their entire length. When the piston reaches the bottom of its stroke this groove uncovers a corresponding groove in the wall of the cylinder which is supplied with oil from the oil pump, and as the entire wall of the cylinder is

also covered with oil from the splash in the crankcase, perfect lubrication of the wristpin is assured.

The lower cover to the crankcase, which is merely an oil-pan, and should contain 2 quarts of oil at all times, is arranged in two compartments, one for each pair of cylinders, each compartment being sub-divided by a rib. Each compartment should contain about 1 quart of oil, or a total of 2 quarts, which can be supplied to the crankcase through the hand hole cover on right side of crankcase or through the front gearcase by removing the winged nut on top. The quantity of oil should give a level of sufficient height to allow the studs of the connecting-rods to be submerged 1-8 inch when at their lowest point. This level should be maintained at all times and the mechanical oiler feed pipe should be regulated accordingly. This arrangement of dividing the oil pan prevents the trouble so often experienced by flooding either the front or rear cylinder in ascending and descending hills and necessitating frequent plug cleaning.

It is advisable to clean out the engine case occasionally by opening the drain cocks in the bottom of the case and cleansing it thoroughly with kerosene, after which the case should be supplied with the original quantity of fresh oil.

The camshaft, magneto and pump gears are inclosed in a case cast integral with the crankcase and are lubricated by the splash from crankcase and by feed pipe from mechanical oiler; pockets are cast in case to retain sufficient oil suitable for all gear bearings.

Magneto Probably Needs Overhauling

Editor THE AUTOMOBILE:—Can you tell me how to wire a single-cylinder engine so that it will work on both batteries and a Wizard type B. C. 1 magneto? The diagram, Fig. 5, shows how I wired it, but it will not work so that it will run on the magneto. Can you show me my mistake? I have tried it with and without the coil in the magneto but to no avail. When I touch the opposite terminal with the end of the wire from the opposite terminal or magneto, it sputters and sparks well but will not make the buzzer on the high-tension coil vibrate when it is connected as I show in the illustration. Only a single spark will show between the platinum points of the buzzer.

2—Will this magneto burn out with the friction pulley on and working right?

3—How many volts and how many amperes will this magneto draw?

This magneto has not been used for 2 years. The magnets seem to draw the armature with difficulty when the end bearing is taken off and the brushes and commutator are clean, but the commutator gets warm when it is run a while and sparks at the brushes every way I adjust them.

Lidgewood, N. D.

L. H. W.

—Your wiring diagram appears to be correct. It is quite possible that the breaker mechanism is improperly synchro-

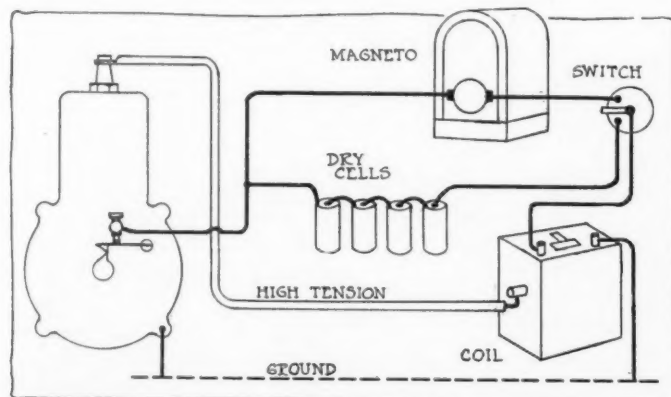


Fig. 5—Diagram for wiring single-cylinder motor to operate on either high-tension magneto or battery and coil

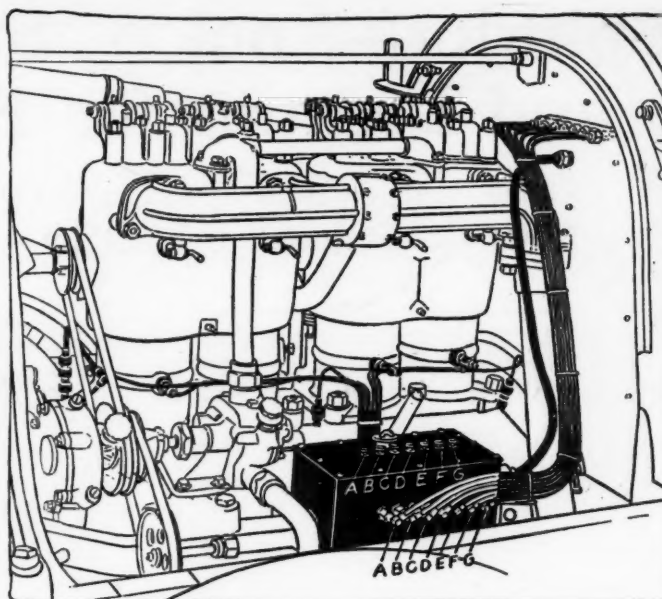


Fig. 4—Details of oiling system on the 1907 Pope-Hartford, with sight feed pipes

nized with the armature position. The breaker points should separate at the same time that the magneto armature is generating the greatest current by cutting the maximum number of magnetic lines of force between the poles. This position of the armature can be determined approximately by rotating the armature shaft and noting the position at which the poles exert the greatest drag. Since the magneto has not been used for 2 years the magnets themselves may have become partially demagnetized, and in view of this it would probably be wise to have the magneto overhauled.

2—The magneto will not burn out with the friction pulley on and working correctly as it is a low-tension instrument.

3—The voltage of this magneto should be in the neighborhood of 6.5 and the amperage will depend upon the speed.

Headlight Lamp Is Out of Focus

Editor THE AUTOMOBILE:—One of the electric headlights on my car throws a smaller radius of light than the other, the lamps being of the same candlepower and one seems as bright as the other. Why the difference?

Scranton, Pa.

V. H. C.

—The probabilities are that one of your lamps is out of focus. If you will examine your lamp you will note that the bulb can be moved forward and backward in relation to the reflector. This adjustment should be made until the ray of light thrown out by the lamp is equal to the others. In order to first ascertain, however, that it is the focal adjustment which is incorrect it would be a good idea to take the bulbs out of the lamps and interchange them. Then, if the same light gives the greatest illumination and the reflectors are both clean, it will certainly be a matter of adjusting the focus. Generally the adjustment of the focus is just back of the lamp proper and is effected by means of a screw.

Lubricate Bushings on Spring Seats

Editor THE AUTOMOBILE:—Would any harm result if I put a metal bushing on a rear axle housing to tighten spring seats on a Buick model B-36. The factory put on a grease cup, but I would rather have it tight, as it seems to make a noise when I go over a rough piece of road.

Angelica, Wis.

J. L. D.

—There can be no harm in bushing the spring seats, providing that care is taken to cut oil grooves and drill holes for grease so that the bearing surface may be kept lubricated.

Splitdorf-Apelco Starting and Lighting for Fords

Single-Unit System with Chain Drive and Automatic Regulation Is Easily Attached

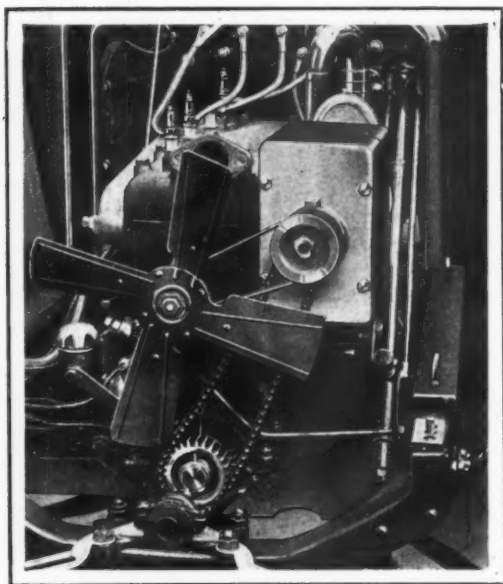


Fig. 1—Splitdorf-Apelco system on Ford showing chain drive to crankshaft

THE latest starting and lighting system for Ford cars is the Splitdorf-Apelco, for which arrangements for manufacturing on a large scale have just been completed by the Splitdorf Electric Co., Newark, N. J. It is a single-unit system, the motor-generator being designed for attachment to the left side of the engine driving by a chain to the front end of the crankshaft. The aim of the design has been to reduce the number of parts to the minimum and simplify fitting to the engine. The complete outfit comprises the motor-generator, a 6- and 12-volt battery with case for mounting on the running board, an adjustable bracket for the motor, starting and lighting switches, chain and sprocket, fan belt, and all necessary cables and clips.

Practically no machining is necessary in fitting, the single exception being a slight cut on the existing fan pulley to take a pulley extension for the new belt by which the fan is driven from the end of the motor-generator shaft instead of the crankshaft.

Chain Adjustment Provided

The cast-iron bracket which carries the motor is attached by three bolts which replace two in the crankcase flange and one at the base of the forward cylinder. The upper face of the bracket, Fig. 2, is hinged at one side for adjustment of the



Fig. 2—The bracket on which the motor generator is mounted permits chain adjustment in both directions, vertically by two set bolts and sideways by the nuts on each end of the hinge bolt

chain. For this purpose two set screws are provided, one for raising and tightening the chain and the other for slackening. Great importance attaches to this feature on any chain driven motor generator set as the drive is from opposite ends in starting and lighting and the strain in starting may be severe. Sideways alignment of the drive is also obtainable by screwing in or out the hinge bolt of the bracket. The gear ratio is roughly 2 to 1, the motor pinion and crankshaft pinion having respectively 13 and 27 teeth. There is no other form of gear, the drive being positive.

In fitting, the existing pulley on the crankshaft for the fan belt is removed

and the chain pinion substituted. It is held in place by a taper pin passing through an existing hole in the crankshaft, a split pin holding this pin in the pinion. Owing to the presence of the chain it is necessary to move the fan belt position further back and it is for this purpose that the pulley extension on the fan is provided. This extension pulley is simply driven on top of the old pulley after taking a slight cut over the flange.

Bucking Coil Regulation

The motor-generator is a two-polar design having two windings, one for generator purposes and the other for starting. Regulation of the current while generating is obtained inherently by the use of bucking coils.

When the unit is operating as a motor the bucking coils are not in use. On generating, however, the main current flows in series around these coils and as they are wound opposite to the main shunt field coils their effect on high speeds is to cut down the magnetization of the fields and hence the current output. Four carbon brushes are used and inspection can be made by removing a lid on the aluminum end cover.

Through the use of a change-over starting switch the battery is connected to supply current at 12 volts for starting though it is charged and the lamps are furnished with a 6-volt current. The starting switch is placed under the floor boards with a plunger pedal projecting near the base of the driver's seat where it can be depressed by the heel.

Charging and discharging is indicated by a positive acting indicator clamped to the base of the steering column which shows the words "ON" or "OFF." An automatic switch in the generator circuit cuts in the generator when the speed reaches 850 r.p.m., which is equivalent to a car speed of about 10 miles per hour. The lighting switch is provided with a dimmer for the headlights.

The complete installation weighs 150 pounds of which the generator represents 38 pounds. Fitting can be accomplished by any repairman in four or five hours. The price complete is \$65.

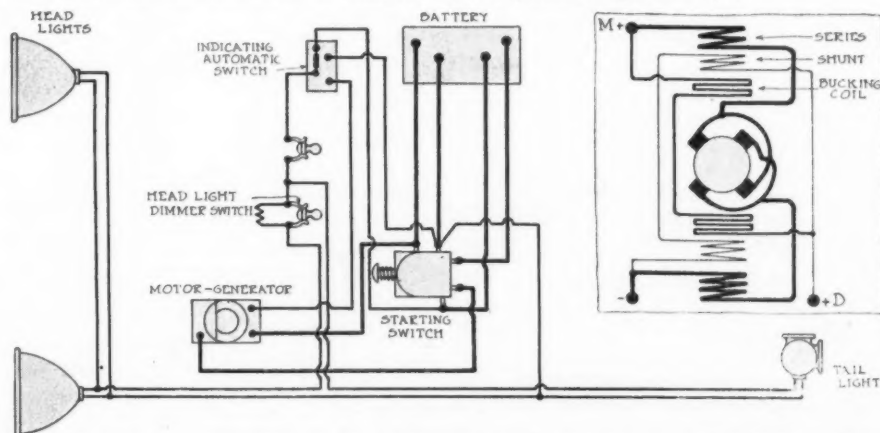


Fig. 3—Diagram of connections of the Splitdorf-Apelco electric system for Fords. Right—Winding diagram of the motor-generator showing the bucking coils which regulate the output

Machines for Warner Gear Making

Ingenious Devices for Gear Blank, Pitch Indicator and Housing Manufacture

IN the factory of the Warner Gear Co., Muncie, Ind., there are three machines which are great factors in the rapidity of production and accuracy. The first is a new design of Cleveland automatic for turning out transmission gear blanks, the second, the fixture for indicating spiral bevel gears on the pitch line, and the third, a boring apparatus for use on the gearset housing. These are illustrated respectively at the top, center and bottom of this page.

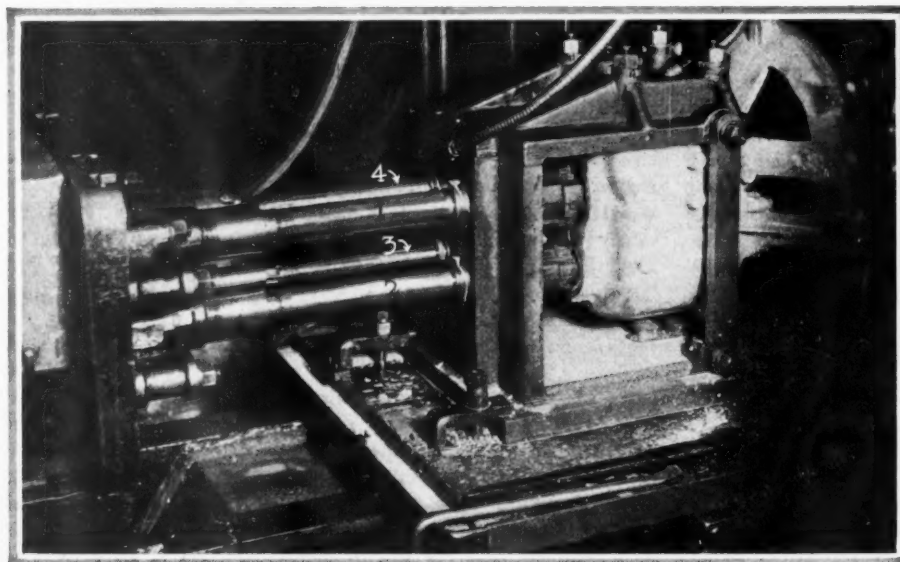
With the automatic, the gears are blanked out complete ready for the gear cutters, from cold rolled bar stock. All the operations after the set-up are automatic. The effectiveness of this machine



New design Cleveland automatic for transmission gear blanks



Specially built fixture for indicating spiral bevel gears on the pitch line



Special machine for fast work in boring the gearset housing

can be judged readily from the size of the chip. With these the cost is cut two thirds because one man takes care of three machines. The time of cutting the part shown, which is the most costly gear blank in the gearset, is 12 minutes. This is a drive gear with 11-inch shank. Each machine handles bar stock up to 6 inches in diameter and weighs 8.5 tons.

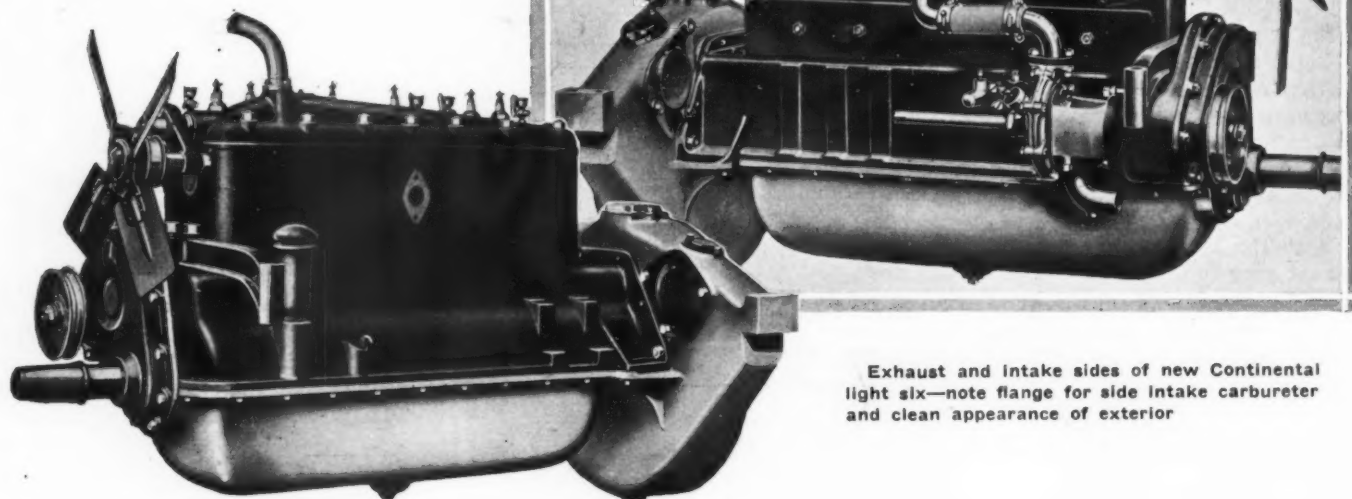
The dial pitch indicator is used in a directly opposite manner from that in which it is generally used. Instead of the indicator pinion being the movable part, it is stationary and the dial itself moves up and down in a vertical plane. A small shaft 3 passing up through the fixture frame has one end turned to a perfect ball and the other attached rigidly to the rear of the indicator dial. An operating lever 2 fulcruming about X raises or lowers the shaft 3 by the means of the pin 2. This raises or lowers the indicator dial 1, and as the indicator pin 5 is stationary on the fixture frame the correct reading will be given on the dial face. In operation the ball pointed shaft drops between each pair of teeth and produces the reading on the dial. A gear having a variation of more than .003 around the entire face is rejected.

Fast work in the boring of the gearset housing is accomplished by the third machine, which was built in the shops of the Warner Company, the jig and tool work being also a Warner product. Boring is the second step, the first being to mill the face.

The boring bars are numbered 1, 2, 3 and 4, respectively for the main countershaft, idler pin and shifter rod holes. The time to bore one of these cases complete is 11 minutes.

Continental Light Six Motor Announced

New Model Has Great Accessibility
With Clean Exterior, Develops 2500 R. P. M.



Exhaust and intake sides of new Continental light six—note flange for side intake carburetor and clean appearance of exterior

THE first of the several new Continental motors to be announced by the Continental Motor Co., Detroit, Mich., is a light six 3.25-inch bore by 4.5-inch stroke. As a performer the engine is a fairly high-speed type since it develops 35 horsepower at about 1,600 r.p.m. and will run up to 2,500 r.p.m. the peak of the power curve being well up towards the maximum speed.

Apart from the neat appearance perhaps the most remarkable feature of the motor is the very large size of the crankshaft which is no less than 2 1/4 inches in diameter. This, it is claimed, completely overcomes torsional vibrations which is an advantage from the point of view of comfort and also because it tends greatly to reduce noise in the timing gears at the front end. This highly desirable quietness is increased by the use of a new compressed cloth material for the camshaft gear, and an engine which we were able to examine on the test block proved that the gearing is almost absolutely quiet at moderate crankshaft speeds.

There is but little aluminum in the motor as the cylinders and upper part of the crankcase are integral, but the flywheel housing is aluminum. This saves weight and, as the bottom portion of the crankcase is pressed steel the whole motor is quite reasonably light.

Valves are accessible by the removal of a cast iron detachable cylinder head which is in one piece, and the valve springs and tappets are located on the right behind the usual inclosing plates. On the right side also is the magneto when this form of ignition is employed, or the generator and ignition unit. Drive for these attachments is obtained by a shaft passing through the water pump and there are openings on either side of the aluminum flywheel housing so that almost any sort of cranking motor can be attached on right or left.

On the left side there is nothing but the carburetor which bolts directly to the cylinder block, all intake passages being internal but the exhaust manifold is, as usual, separate.

Lubrication is the combination force feed with dip troughs for the crankpins generally associated with Continental motor practice. Oil under pressure goes to the three main

crankshaft bearings and to the helical timing gearing. Overflow thence fills the dip troughs and splashers on the connecting-rod bearing caps distribute the oil to all other parts.

As instancing the convenience of this motor to car manufacturers it should be observed that the practice of making the flywheel housing in aluminum, bolted to the iron of the crankcase, enables the housing to be varied a little to suit individual maker's requirements. The standard housing is one of the S. A. E. sizes which the society expects to standardize shortly, but it is possible to alter this cheaply.

For setting the motor in the frame a three-point suspension is arranged in such a way that there are four points of attachment to the chassis, and this is easier to provide than three points with a swivel bracket on one of the cross rails. At the rear end are the usual aluminum arms integral with the flywheel housing, and to the front end is attached a drop-forged beam. The two ends of this beam can be bolted to the car frame and the front end of the motor hangs from the middle of the beam.

We understand that the price to manufacturers of this new engine is distinctly lower than that of any previous Continental models, either four or six cylinder, of equivalent total piston displacement, this being made possible by a design that is a trifle more simple as a manufacturing proposition. Certainly the Continental company has never made a neater looking job, nor one that runs more smoothly.

Great developments are in progress at the Muskegon plant of the company where a new three-story building 60 by 150 feet is being erected. Two lines of test blocks to accommodate a hundred more motors are being added to the test room at Detroit and sundry small building additions are also being made to this plant. While trade has never before been so brisk the company expects it to be still better during the year and have had to refuse consideration of some substantial foreign orders owing to its inability to do more than satisfy the most pressing part of the home demand. It is said that the aim for the immediate future is an output of 500 motors daily.



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S. A. E. Sets High Standard

THE quality of the papers read at the Society of Automobile Engineers' summer meeting and of the discussions thereon reflects great credit upon the authors, the speakers and the society. Discussions were hurried a little by pressure of number of papers on the program, but this seemed to serve merely to persuade speakers to come rapidly to the point.

The paper on the fundamentals of motor design was, of course, the most topical of all, and served as opportunity for obtaining the opinions of several prominent engineers on the situation created by the coming of multi-cylinder motors. These opinions were given in a frank, direct way and it was very impressive how most of the speakers refrained from giving their ideas as convictions. It may be doubted if such leaders of thought have ever before expressed themselves as quite so indefinite as to the future.

Another paper of unusual merit was that dealing with the spiral-type bevel and it was obviously appreciated by many as being a successful attempt to explain the detail of this type of gearing. In the discussion on this paper a very healthy condition was indicated in the absence of axe grinding by the sponsors of worm and bevel gearing, and throughout the whole meeting there could be no mistake as to the genuine nature of the opinions given.

The S. A. E. stands for the interest of the indus-

try at large, and the interchange of ideas is one of the greatest reasons for the existence of the S. A. E. Thus it is more than encouraging to hear discussions of so high an order of frankness. Too often in the past, after hearing the expressed ideas of some leading engineer there has remained a doubt as to whether the things he said were the things that he believed fully and truly. At the 1915 summer meeting there was hardly an instance where the man who spoke did not create with his words an atmosphere which assured their complete sincerity.

Tire Economy

TIRE manufacturers and car manufacturers both agree that many of the cars of today are undertired, but instead of solving the problem, now that the solution is offered, both parties seem to hold aloof from action in this much needed reform. Last week before the Society of Automobile Engineers, the representative of one of the largest tire manufacturers stated that fully 33 per cent. of all automobiles are undertired.

This is a serious situation, and the short-sighted policy of clipping a few dollars from the sales price of a car for the sake of a sales talking point will react when owners begin to realize, as they are already beginning, that this few dollars saving in first cost will mean many dollars loss in tire replacements.

The amount of money wasted in tires is inconceivable under present conditions. When an expert who is in the tire business estimates that 30 per cent more tires are worn out annually than should be the case, it is time to call a halt. The car users are the first sufferers because it is they who have to foot the tire bills, but the car manufacturers themselves are the ones who will suffer in the long run in many ways. In the first place, many are kept from owning cars by the thoughts of large tire bills. In the second place, cars which would be easy on tires, were the proper size used, soon get the reputation of being hard on tires, merely because, for the sake of a few dollars on each car, they have cut the tire size to the limit.

Something must be done, and the solution is logical. Let car manufacturers and tire makers get together and decide, on a weight basis, what tire size should be used and let the car manufacturer send out his cars equipped with the correct even size, leaving the owner to put on the odd or oversize if desired, for particularly arduous service.

Frank Discussions

NOTHING can be gained by a man keeping his knowledge to himself in an industry where the necessity for progress is so marked as that concerned with the manufacture of automobiles and related articles. Each one must contribute his share in the up-building of knowledge, and for this reason frank discussions at engineering meetings are highly desirable. Such discussions were had at the summer meeting of the S. A. E.

S. G. V. Cars Will Be Continued

Manufacture Will Be Started in Met. District—Plans Yearly Production of 400

NEW YORK CITY, June 19—The manufacture of the S. G. V. car will be continued. R. J. Metzler, who bought the plant at Reading at the receiver's sale on May 27, has bought outright the name, good will, patterns, drawings, jigs, dies and the right to continue the business.

Mr. Metzler is now perfecting a new organization to go into active manufacturing of the car and expects to start active work in about a month with a production of about 400 cars a year. At present the New Jersey Machinery Exchange, 23 Mechanic street, Newark, N. J., of which Mr. Metzler is a member, is giving S. G. V. service in that city.

The plant has not been decided on, but Mr. Metzler states that it will be either in Newark or Long Island City. The thirty-two complete chassis offered for sale at the auction on June 9 were bought by Mr. Metzler.

Knox Motors Associates Take Care of Sales and Advertising

SPRINGFIELD, MASS., June 17—With a view toward reaching the highest possible degree of efficiency in its selling organization, the Knox Motors Co., Springfield, Mass., has transferred its sales and advertising work to a trust association known as the Knox Motors Associates. This association will act as sole distributors for all Knox products. The officers of the Knox Motors Associates are: President, H. G. Fisk; clerk, C. H. Beckwith; treasurer and general manager, E. O. Sutton.

The Knox company has recently put on the market a highly efficient four-wheel tractor designed for all kinds of heavy highway hauling and especially adapted to the hauling of such heavy materials as lumber, coal, structural steel, ore, contractors materials, etc.

Wuchter and Werner Head \$2,000,000 Tire Co.

NEW YORK CITY, June 19—The Kansas City Tire & Rubber Co., recently incorporated in New York State by P. E. Werner, of Akron, O., and W. W. Wuchter and Philip Freshwater, has purchased the Chester Rubber Tire and Tube Co. plant in Chester, W. Va., as part of the above \$2,000,000 incorporation. The Chester plant will be enlarged and its capacity doubled by the new management, and will supply the eastern tire

and rubber products trade, while another plant, recently purchased by the company in Kansas City, will supply the central district.

Mr. Wuchter has been very prominent in the tire field, having been connected with the Firestone Tire & Rubber Co. as superintendent, and later as president and general manager of the Swinehart Tire & Rubber Co. Mr. Freshwater is general manager of the Chester plant.

Canadian Plant for Chevrolet

NEW YORK CITY, June 22—The Chevrolet Motor Co. of New York, is about to establish a plant in the Dominion of Canada, probably in Toronto, Ont., though the location has not been definitely decided upon. Thomas Houghton, formerly with the Dominion Carriage Co. has been appointed Canadian representative. It is planned first to build the "Four-Ninety" model and later to produce the complete Chevrolet line for Canadian consumption. It is expected the plant will have a capacity of 15,000 cars per year.

Warner Now Oakland's General Mgr.—Other Officers Promoted

PONTIAC, MICH., June 18—Several important promotions have been made among the officers of the Oakland Motor Co., by president Charles H. Nash, of the General Motors Co., of which the Oakland company is a subsidiary. Fred W. Warner, who has been general sales manager is now general manager; C. B. Voorheis, who was assistant sales manager, becomes general sales manager and Thomas H. McDearmon, of the department is made assistant general sales manager.

Mr. Warner was formerly manager of the Buick Motor Co.'s branch in Chicago; Mr. Voorheis was general manager of the Kingman Plow Co., Peoria, Ill.; Mr. McDearmon was general sales manager and assistant general manager of the John Deere Plow Co., Kansas City.

Co-operative Grocery Delivery

CHAMPAIGN, ILL., June 19—A co-operative delivery system for groceries, meat markets and similar lines has been started in this city and by means of which it is claimed 50 per cent. in the cost of delivery will be saved. A sufficient number of motor delivery wagons to care for the work have been purchased. The forty delivery men who heretofore have been employed by as many firms in these lines will be displaced by the new system. Half of these will enter the employ of the company caring for the co-operative system and the other half will take positions as clerks, etc. This plan of co-operative delivery is working successfully in Galesburg and other Illinois towns.

Reduced Studebaker Car Prices

Sixes Cut \$400—Fours Reduced \$100—Many Chassis Refinements—Delivery Prices

DETROIT, MICH., June 21—For 1916 the Studebaker Corp. has reduced the prices in its six-cylinder and four-cylinder models notwithstanding body refinements and numerous chassis improvements included. The price on the six-cylinder, seven-passenger car has been cut \$400. The price on the four-cylinder touring car is cut \$100. The six-cylinder roadster is now priced at \$1,000, and the seven-passenger touring car is \$1,050. Last season's five-passenger six was \$1,385 and the seven-passenger \$1,450. The four-cylinder touring car in the new series is to sell for \$885, as compared with \$985 this year. The roadster is \$850, compared with \$985.

There has been much standardization of the two chassis, and this is probably influential in the lowering of prices. The motors are both increased in bore from 3 1-2 inches to 3 7-8 inches, with the stroke remaining at 5 inches. Most noticeable in the engine changes is the removal of the cross shaft at the front, and the new mounting of the generator vertically with spiral drive.

Greater Accessibility

The whole chassis has been gone over with the main idea of attaining greater accessibility. Greater quietness has been striven for. The bodies have better lines, and there is no suggestion of break between body and the hood.

The new Studebakers use a modified form of Wagner electrical system in connection with a Remy ignition distributor. A special and advantageous feature of the electrical system is the placing of the wiring junction box on the right rear of the motor. Removal of its cover plate makes all connections accessible, and the wiring on the body is eliminated.

The wheelbase of both cars has been increased, being 1 inch longer on the six, 122 inches. The four is lengthened from 108 to 112 inches. Due to modifications in the suspension, the cars are lower, and the frame has been strengthened. Both cars are fitted with 33 by 4 tires.

On a modified four-cylinder chassis, the delivery car is fitted. This uses the same engine, and the chassis differences are only such as needed for such service. The springs are heavier and frame longer. With panel body, it is to sell for \$875; express type, \$850; combination express and passenger-carrying design, \$875. Formerly the delivery types sold for \$1,050.

Goodyear's \$400,000 Addition

Adds 5 Acres Floor Space and Raises Daily Output from 12,000 to 15,000

AKRON, O., June 19—Five acres of additional working floor space are included in plans approved this week by the directors of the Goodyear Tire & Rubber Co., which will begin at once an extension of the Akron factory made necessary by the continued growth of the business. This will give the plant a total floor area of nearly 50 acres.

The new buildings will be ready, with machinery installed, by the beginning of the fiscal year, November 1, and will require for their use 2,000 additional men, bringing the Goodyear working force to a total of 10,000.

Goodyear's present capacity in automobile tire production is over 12,000 a day. The new buildings will enlarge the capacity to well over 15,000 tires a day. The cost of the plant enlargement will be \$400,000. All the buildings are to be of brick and steel, to harmonize with the present plant, and room will be found in them to extend the manufacture of mechanical goods.

Bell Factory Starts Production in New Plant

YORK, PA., June 19—Operations at the plant of the Bell Motor Car Co., York's latest addition to the automobile industry, was started this week. The company expects to build a number of cars this month and material for their manufacture is arriving. The company expects to have its plant in full operation by the middle of July. W. F. Grove, for the past several years connected with the sales department of the Pullman Motor Car Co., has been appointed as sales manager. Workmen have been busy at the plant during the past several weeks in making the necessary improvements and installing the machinery and other equipment. The Bailey Mfg. Co., engaged in the manufacture of commercial automobile bodies, which occupied the plant, has moved to North Wales, near Philadelphia, where a large plant has been erected and the company will engage in the manufacture of bodies for Vim cars.

Studebaker's Annual Convention

SOUTH BEND, IND., June 21—The annual convention of the automobile branch managers of the Studebaker Corp. was held here Friday and Saturday in the administration building of the corporation. About twenty automobile dealers of the larger cities and the Detroit and

South Bend officials were also in attendance. The annual conventions have heretofore been held in Detroit, but this year a change was made to South Bend in order to permit the managers and dealers to become more familiar with the South Bend plants which are now making the automobile bodies, castings, springs and stampings. Those attending were: J. M. Studebaker, sr.; F. S. Fish, E. R. Erskine, G. M. Studebaker, C. C. Hanch, H. E. Dalton and W. F. Shillington. Detroit officials: E. R. Benson, L. J. Ollier, R. T. Hodgkins, H. T. Myers, G. L. Willman, H. A. Biggs, James G. Heaslet, M. S. Wollering.

3,800 White Men Get Wage Increase

CLEVELAND, O., June 16—About 3,800 employees of the White Co., will receive increases in wages amounting totally to about \$1,786 a day.

The move is an effort of the company to keep the good men it has in its employ. The demand for war material, according to the president of the company, Windsor T. White, has created a scarcity of skilled labor in mechanical fields.

Under the new schedule all men on day work will receive the same pay for 8 hours that they have been receiving for 9 hours' work. Time and a half will be paid for the 9th hour and all other hours of overtime.

The factory is to run 9 or more hours daily as long as the work holds out. A man who has been earning 25 cents an hour during a 9-hour day will now receive \$2.25 for 8 hours' work and an additional 42 cents for the 9th hour.

Overland's 1916 Shipments 12,000 Up to June 12

TOLEDO, O., June 19—Up to June 12 the Willys-Overland Co. had shipped 12,000 of the new 1916 cars, and the company is now over 21,000 immediate shipping orders behind.

The present shipping schedule calls for the shipment of about 380 cars a day. May was the largest month in the history of the company, and sales were 54 per cent. ahead of those for the same month last year.

De Kalb Car on Street

ST. LOUIS, MO., June 17—The De Kalb Motor Car Co., this city, has one of its first De Kalb delivery cars on the street. It is a 45-horsepower, six-cylinder car, selling for \$2,250 with choice of body at option of the purchaser. The same chassis will also be used for touring car bodies. The new car's motor is a Beaver and carries the Apple starting and lighting system, Stromberg carburetor and Remy magneto. The rear axle is floating Timken; semi-elliptic springs are used. The wheelbase is 130 inches.

1916 Briscoe Has Larger Motor

Uses Ferro Motor in Eight— Drops Single Headlight— Cantilever Springs

JACKSON, MICH., June 24—Nineteen-sixteen plans for the Briscoe Motor Co., of this city as intimated a week ago are now complete, and the company will manufacture a chassis in which either a four-cylinder or eight-cylinder motor may be used. The price of the four-cylinder job has been cut \$35.

The four-cylinder engine is entirely remodeled over that used in the previous model, and though the car is an improved design throughout, the price has been reduced from \$785 to \$750.

The eight-cylinder model lists at \$950, and being on the same chassis, either engine will go in either car. The Briscoe company will sell the eight engine for \$225 additional. The eight-cylinder motor is of the Ferro design, with overhead valves already described in these columns.

The new four-cylinder motor has the same stroke as formerly, 5 1-8 inches. The bore is larger, 3 7-16 inches as compared with 3 1-8 inches. The cylinders are cast in a block, and a very smooth outward appearance has been given the power plant. The gearset is not in unit with it, but is suspended independently amidships.

The chassis has been lengthened from 107 to 114 inches, giving more room in the back seat. Cantilever rear springs are a departure from the semi-elliptics used previously. A noticeable change is in the using of two headlights in conventional manner instead of the single headlight in the middle of the radiator as previously.

Tires are increased from 30 by 3 1-2 to 32 by 3 1-2. The brakes have been changed from the double-internal-expanding variety to the internal-expanding and external-contracting form. The rear axle has been changed to a floating design. Three body types—roadster of the clover-leaf seating form, touring car and coupé—are to be had at the prices given.

To Sell Pope's Westfield Plant

BOSTON, MASS., June 19—Judge Aldrich of the United States district court has issued a decree ordering the sale of the Pope bicycle plant at Westfield, Mass., on July 20. George Pope, Chas. A. Morse and Chas. A. Parsons receivers for the Pope Mfg. Co., in their report stated that H. Preston Cousens of New York had offered to bid not less than \$725,000 for the property if a sale was arranged not later than July 20. As this

time was but a month away the receivers agreed that it would be wise to have immediate action taken upon the matter. In their report they stated that no reorganization plan had been presented to them by the creditors, and that they can continue to administer the plant at Westfield economically and successfully for an extended period only by losing considerable free cash now on hand.

Thomson of Thomas Drive Here

NEW YORK CITY, June 23—Hedley J. Thomson, managing director of the Thomas Foreign Patents Co. Ltd., holders of the patents on the Thomas gasoline-electric transmission is in this city for a short time on his way back to England after an extensive trip in the interests of the Thomas drive.

Mr. Thomson left England in July, 1914, for Australia together with a party of other members of the British Association, an organization for the general advance of science, and before a meeting in Melbourne in August, read a paper on the Thomas drive. He spent 3 months in Australia and 6 months in New Zealand, his home. Mr. Thomson's company holds extensive patents in this country on his drive and he expects to return here shortly, if his plans permit, to interest American manufacturers.

Dodge Now Making Roadster

DETROIT, MICH., June 21—Thus far Dodge Bros. have been building only touring cars, although they announced quite a while ago that they would also supply a roadster at the same price as the five-passenger car. Orders for this model came, however, in such quantity that for months all attention was given to the building of this style. Now, however, production has progressed to the extent of making it possible to also take care of the demand for roadsters and the first of these models are now being shipped to dealers and distributors.

The Dodge roadster differs from the Dodge touring car only as far as the body is concerned. It seats two passengers but is otherwise identical in construction to the larger car. It sells at the same price, \$785.

50,000 Plugs a Day

FLINT, MICH., June 21—The Champion Ignition Co., manufacturers of spark plugs will increase its production capacity to 50,000 spark plugs a day when the addition to the plant is completed.

This new building, two stories high, 146 by 60 feet, will increase the floor space 20,000 square feet. It will be used by the engineering, tool and porcelain departments and the present factory building will be used for finishing the product.

Truck Shipments Unsatisfactory

McCulla Back from Europe Exposes Faults in American Trucks

NEW YORK, June 22—Wm. R. McCulla, assistant chief engineer of the Knox Motors Co., Springfield, Mass., who has been abroad investigating the truck situation in the war zone, returned last Saturday and has many startling confessions of the American truck situation in connection with the war. Mr. McCulla believes that one of the greatest evils in the present exporting of American trucks is that they are poorly crated, many of them being badly rusted when they reach the other side and some of them almost unable to run because of this condition. Some of the concerns have picked out very poor types of men to represent them in Europe.

Mr. McCulla says that where an error is being made is in not having the very best factory organization to handle the trucks when they arrive in Europe. Some organizations are leaving all the work to soldiers, which includes the unpacking and setting up of machines with the result that because of this unskilled help some of the machines operate very badly. Fatal accidents have happened before some of the trucks have gotten 10 miles from the seaport because of this.

Mr. McCulla mentions personally seeing three or four machines in which the magneto was set exactly half way around on the driving dog so that it was not firing at the right periods. On others the wiring was wrong, and valve tappets were not adjusted on others.

One American company has made a very enviable reputation for itself by careful business-like work in connection with shipping its trucks abroad and tuning them up over there. The trucks are well crated and the company has exceptionally good men at the landing stage. These men in turn employ four or five good French mechanics who thoroughly understand their business and who are not carried away with the sensation of working in a strange country and so go about their work in a business-like manner. The company representative at the landing port simply walks around and sees that each truck is positively O. K. before it leaves the port.

Concerning tractors Mr. McCulla believes the Panhard to be the best used in the war. The Renault is well designed but due to lack of time has apparently not been so well worked out. Some tractors in operation have not sufficient cooling facilities and have to carry additional water tanks.

Mr. McCulla officially demonstrated the Knox tractors to the engineers of the motor transports and made two trips to the firing line, thereby having an opportunity to observe the entire transportation methods at work. He reports that to date the French have had rather poor success hauling their big guns with tractors. He says that the new French gun will be hauled by tractors and that the lightest unit of it will weigh 40.5 tons, all the weight carried on four wheels.

Apperson Eight and Six

NEW YORK CITY, June 19—The Apperson Bros. Automobile Co. will drop the four-cylinder car in 1916 and will manufacture only sixes and eights. The six will be the same as the 1915 model. The body types will include a roadster with four seats, of which the two front seats are individual chairs. The new roadster body will be mounted on either the six or the eight chassis.

The eight motor 3 1-2 by 5, develops 55 horsepower, and is of the V-type mounted at a 90-degree angle, the cylinders being cast in fours. The car has a wheelbase of 128 inches and a tread of 56. Other features are: left drive, center control; gasoline tank in rear, and Stewart vacuum feed.

Adopts Automatic Spring Machine

RACINE, WIS., June 19—The Harvey Spring Co., Racine, Wis., car and truck springs and axles, has developed and installed in its plant a new device for automatically forming spring leaves and quenching the spring in oil. While the old method of forming and quenching springs by hands required an expert spring maker and a helper, the new device makes it possible for a single expert to attend single-handed to a battery of machines. The output of one machine alone is at least four times that obtained by hand work. With the new machines the Harvey plant is able to turn out daily twenty-five sets of twelve-leaf 2 1-2-inch springs, 50 inches long.

DETROIT, MICH., June 21—The Packard Motor Car Co., has placed a contract with the Burd High-Compression Ring Co., to use their patented piston ring for 1916.

To Conclude Detroit Electric Run This Week

DETROIT, MICH., June 21—The Anderson Electric Car Co. will conclude this week a series of 20 daily interurban runs which it has been conducting since June 1 for the purpose of demonstrating the possibilities of the electric in runs of one battery charge. The company maintains that the car is sufficient for 98 per cent. of the motorist's demands. The model of cars used is a fifty-two brougham, equipped with Detroit lead

batteries, Goodrich Silvertown cord tires and Houk wire wheels. Guests are invited to take the trips, the cars stopping at their residences for them and the company furnishing a basket lunch.

Automobiles for China

NEW YORK CITY, June 19—A representative of interests in China, Gallant Goo has made inquiries at the Bureau of Foreign and Domestic Commerce in regard to automobiles. Mr. Goo wants to take back to China catalogues of manufacturers of automobiles, motor supplies, and vehicles. Upon his return home he will form a company capitalized at \$100,000 to handle foreign cars and vehicles generally. According to Mr. Goo the prospects are good for an excellent business in American cars in that country as soon as the people are educated up to their use. Those interested may communicate with him by addressing S. H. Rose, Acting Agent in charge of the bureau, Room 409, Custom House.

A. O. Smith Pioneer Dead

MILWAUKEE, WIS., June 19—T. M. Custer, general purchasing agent of the A. O. Smith Co., Milwaukee, frames, parts and trucks, and a well known steel man in the country, died at Milwaukee June 17 of peritonitis, following an operation for appendicitis on May 21. Mr. Custer was born in South Ronaldshay, Orkney Islands, Scotland, in 1872 and came to America in 1891. He sailed the Great Lakes for a number of years and just as he was eligible for a master's or captain's license, he turned his attention to metallurgy, being employed by important steel and iron concerns in Elyria, O., Chicago and Cleveland until 1909, when he became associated with A. O. Smith Co. as a steel expert, shortly afterward being named chief purchasing agent.

Stanton Sails for London

NEW YORK CITY, June 19—A. T. Stanton, Dodge Bros.' newly appointed district representative for the British Isles sailed today on the steamer St. Paul. Mr. Stanton will have his headquarters in London, and will be in charge of Dodge Bros.' affairs in the British Isles.

Velie Manager Resigns

MOLINE, ILL., June 19—Ray R. Bush, general manager of the Velie Motor Vehicle Co., has resigned to engage in business in Kansas City.

Kelly-Springfield Tire May Add

AKRON, O., June 19—The Kelly-Springfield Tire Co. is seriously considering a further enlargement of the plant here. The works are now running on a 24-hour schedule and are rushing orders. The output this week has run up as high as 1,100 tires a day.

Gasoline Price War Rages

Colorado Price Lowest in 20 Years—Cut 6 Cents in Ohio in Week

DENVER, COL., June 22—*Special Telegram*—The price of gasoline in the Rocky Mountain region has reached the lowest mark in the last 20 years. Filling stations are selling at 13 cents per gallon, and garages are charging from 13 to 17 cents. The oil companies are selling direct to consumers at 12 and 13 cents in 25-gallon lots. The price to the trade is 11 cents per gallon. These lower prices have been brought about by an additional cut of 1 cent per gallon which is the second in 6 weeks. Small independent operators blame the Standard company for starting both cuts and predict still lower prices. Contrasting to-day's prices with those in vogue 18 months ago, when garages bought at 18 cents and sold at 22 cents per gallon, the advantage to the consumer can be seen.

Ohio Price Cut

CINCINNATI, O., June 22—*Special Telegram*—Gasoline prices have been reduced in general throughout the state of Ohio. The latest cities to be affected by the reductions are Cincinnati, Lorain and Cleveland. In most cases the Standard Oil Co. has started the reductions and the independents have met them.

The price of gasoline in Cincinnati has been reduced from 12 to 11 cents per gallon to consumers by the Standard and the independents have met the reduction. A drop to 10 cents in the near future is promised. The independents state that the reduction is due to the immense accumulation of gasoline on the hands of the Standard company, owing to the inability to ship abroad on account of the war.

A dispatch from Lorain states that the price of gasoline has been dropped by the Standard company to 9 cents a gallon, thus renewing the gasoline war on its northern Ohio competitor, the Lake Erie Oil Co., Cleveland, which has established service stations for motorists at every cross-road. The Lake Erie Co. is meeting the reduction. The extent of the present war can be realized by the fact that gasoline at Lorain has declined 6 cents per gallon since last Thursday.

Long Can't Contest Interference

NEW YORK, June 23—On June 8, 1915, the Commissioner of Patents, head of the United States Patent Office, Washington, D. C., sustained the decision of the examiners in chief, who in turn had affirmed the decision of the law examiner, holding that G. F. Long has no right to

contest the interference with E. Aufero and the Auto Supply Mfg. Co. of Brooklyn on mechanical horn patents.

Toback Gets New York King

NEW YORK CITY, June 21—An important change in the New York field is the appointment of Samuel S. Toback, president of the A. Elliott Ranney Co., formerly distributor of Hudson cars who will handle the King line. The A. Elliott Ranney Co. has moved into the building occupied by the King, Broadway at Fifty-second street. Mr. Toback takes with him the same organization that has surrounded him during his 5 years in the Metropolitan district, with C. G. Taylor as sales manager.

Haynes Co. Makes Changes

KOKOMO, IND., June 17—The Haynes Automobile Co., this city, has made several important changes in its organization, the new appointments to go into effect immediately.

R. Crawford, for the past 18 months directing the sales of the company, has been appointed general sales and advertising manager. D. L. Watson graduates from assistant sales manager to sales manager. J. L. Larkin, previously sales promotion manager, has been appointed assistant sales manager.

S. A. Merinbaum, during the past year advertising manager of the company, has been appointed sales promotion manager. H. A. Minturn succeeds Mr. Merinbaum as advertising manager, he having previously occupied the position of manager of the technical bureau. Mr. Minturn's successor has not yet been named but negotiations are already under way with several Purdue University graduates in mechanical engineering.

Duffield Qualitry Sales Manager

CHICAGO, ILL., June 21—J. E. Duffield, formerly manager of the Chicago branch of the Thermoid Rubber Co., has resigned to take a position as sales manager of the Qualitry Rubber Co., Chicago.

Liston Promoted

CHICAGO, ILL., June 19—J. H. Liston, manager of the Detroit branch office of the Thermoid Rubber Co., has been promoted to western district manager of the Thermoid Rubber Co., with sales offices located at 2009 South Michigan avenue, Chicago.

Cunningham 1916 Out

ROCHESTER, N. Y., June 18—The 1916 Cunningham has been announced. Changes include new body with divided front seat, new top and curtains, Westinghouse generator, dry-plate clutch, Westinghouse starter, drawn steel tank, new speedometer drive from universal and simplified brake linkage.

Truck Exports Gain Seventy Fold

Britain Greatest Buyer—Italy Drops—None to Germany—Canada Decreases

WASHINGTON, D. C., June 21—Supplementing figures previously published in THE AUTOMOBILE showing the gross figures of exports of motor cars during April, the Department of Commerce today issued the detailed figures and they are of decided interest to the motor car industry. As previously set forth the exports of commercial cars increased from fifty-two, valued at \$72,676, in April, 1914, to 2,267, valued at \$5,240,481, in April, 1915, an increase of over seventy-fold; while during the 10 months, ended April, these exports increased from 595 commercial cars, valued at \$934,330, in 1914, to 8,580, valued at \$23,977,968.

On the other hand, the exports of passenger cars dropped from 3,239, valued at \$2,760,478, in April, 1914, to 3,078, valued at \$2,804,741, in April, 1915, while the exports for the 10

months' period dropped from 23,167, valued at \$20,664,480, in 1914, to 14,641, valued at \$12,356,472, in 1915.

Exports of parts, not including engines and tires, increased in value from \$626,132 in April, 1914, to \$1,807,567, in April last, and from \$5,549,471 to \$5,924,175 during the 10 months' period.

Europe Gains

Naturally the bulk of our motor car exports are going to the warring European nations. The United Kingdom was a big buyer of American cars and trucks during April, 1915, the total being 1,455, valued at \$1,925,280, as against 587 cars, valued at \$514,977, in April, 1914. During the 10 months' period these exports rose from 6,319, valued at \$5,057,100, in 1914, to 7,652, valued at \$10,840,309, in 1915.

France likewise is becoming a big buyer of our motor trucks and cars, the purchases having increased from 311, valued at \$179,230, in April, 1914, to 1,055, valued at \$1,710,702, in April, 1915, and from 1,011, valued at \$688,471, in 1914, to 3,951, valued at \$10,035,842 during the 10 months' period of this year.

Under the heading of "other Europe," which includes all of the European coun-

tries with the exception of United Kingdom, Germany, France and Italy, surprising gains are shown, the exports having increased from 500, valued at \$372,857, in April, 1914, to 855, valued at \$2,535,169, in April, 1915, and from 2,241, valued at \$1,777,826, to 2,118, valued at \$6,129,392 during the 10 months' period. The natural inference is that trucks figured largely in the exports, as the value of the exports increased in value almost five-fold during the 10 months' period.

Italy is a poor customer, that country's imports from this country having fallen from fifty-nine, valued at \$39,240, in April, 1914, to twenty-three, valued at \$9,983, in April, 1915, while during the 10 months' period the exports to that country declined from 293, valued at \$203,048, to 88, valued at \$58,368.

Germany's contribution to American motor car makers was 234, valued at \$163,101, in April, 1914, while in April last there were none of these exports to that country. During the 10 months' period the exports decreased from 1,185, valued at \$840,448, in 1914, to 20, valued at \$20,164 during 1915.

Canada likewise is not taking many American-built motor cars at this time,

(Continued on page 1139)

Automobile Exports and Imports for March and Preceding Nine Months

EXPORTS							
April				Ten months ending April			
1914		1915		1914		1915	
Number	Value	Number	Value	Number	Value	Number	Value
Automobiles							
Commercial	52	2,267	\$5,240,481	595	\$934,330	8,580	\$23,977,968
Passenger	3,239	3,078	2,804,741	23,167	20,664,480	14,641	12,356,472
Total	3,291	5,345	\$8,045,222	23,762	\$21,598,810	23,221	\$36,334,440
Parts of (not including engines and tires)			\$1,807,567		\$5,549,471		\$5,924,175
EXPORTS BY COUNTRIES							
Automobiles							
France	311	1,055	\$1,710,702	1,011	\$688,471	3,951	\$10,035,842
Germany	234			1,185	840,448	20	20,164
Italy	59	23	9,983	293	203,048	88	58,368
United Kingdom	587	1,455	1,925,280	6,319	5,057,100	7,652	10,840,309
Other Europe	500	855	2,535,169	2,241	1,777,826	2,118	6,129,392
Canada	792	696	611,797	3,347	4,336,407	2,768	3,165,739
Mexico	6	6	4,025	160	248,497	64	63,660
West Indies and Bermuda	49	247	119,893	457	437,093	1,121	696,210
South America	137	98	60,437	1,729	1,719,422	906	494,488
British Oceania	276	307	270,230	3,353	2,909,643	2,471	2,059,033
Asia and other Oceania	211	394	560,845	1,875	1,802,247	1,340	2,119,888
Other countries	129	209	236,861	1,792	1,578,608	722	651,347
Total	3,291	5,345	\$8,045,222	23,762	\$21,598,810	23,221	\$36,334,440
Tires for Automobiles							
Belgium					\$15,429		
France							\$6,090
Germany					105,254		
England			\$378,738		1,162,418		1,909,439
Canada			77,008		680,596		541,400
Cuba			21,023				138,853
Mexico			7,701		105,888		81,050
Australia			26,421				160,736
Philippine Islands			48,808		121,357		209,439
Other countries			105,344		492,402		505,644
Total			\$665,043		\$2,683,344		\$3,552,651
IMPORTS							
Automobiles	15	33	\$37,795	260	\$569,835	277	\$442,816
Parts of (except tires)			85,754		583,568		725,969
Total automobiles and parts of			\$123,549		\$1,153,403		\$1,168,785
BY COUNTRIES							
Automobiles							
France	7	7	\$7,956	117	\$277,380	47	\$108,327
Germany	2			17	40,828	6	13,606
Italy	3	16	20,141	47	70,068	107	117,061
United Kingdom	1	4	7,946	38	113,557	64	150,978
Other countries	2	6	1,752	41	68,002	53	52,844
Total	15	33	\$37,795	260	\$569,835	277	\$442,816

Ford to Build Tractor Plant

Buys 2,000 Acres for Industrial City—500,000 Farm Tractors Annually

DETROIT, MICH., June 19—The first active step in the manufacture of the \$200 Ford tractor described some time ago in THE AUTOMOBILE was taken last week when the Ford Motor Co. secured between 1,000 and 2,000 acres of land just beyond the city limits near Dearborn and Oakland where it is planned to erect for the manufacture of these tractors and where blast furnaces and other steel shops will be erected for the production of Ford parts. The plans have in mind the eventual employment of 20,000 men and the manufacture of approximately 500,000 tractors for farm work annually. A large amount of the ground will be reserved for the erection of working men's homes in this new industrial city.

No Delay on Plants

Work will be started with the least possible delay as it is expected that many years will be required before the new industrial city is entirely completed. The main plants, such as the tractor factory, the blast furnace, are expected to be ready for operation within a year or two.

When these new plants are completed, and possibly even before, it is the intention of the Ford company to operate the present plant in Detroit exclusively for the manufacturing of the bodies, tops and parts to be used for the Ford cars, the latter to be all assembled in the assembling plants.

Ready Materials

In speaking about his new plans Henry Ford made many interesting statements and comments: "Materials which we need for making our cars are not available or are received in such small quantities that it has and is causing much disturbance in our manufacturing plans. Were it not for the war these needed materials would be here, they would be received as before the war started, in sufficient quantity, but for some reasons, it seems that first attention is being given to those concerns making war material.

"It is my intention to be able in the future to avoid such a state of conditions. We will get the ore on our own ships and bring it to our new works where we will make our own steel, at our mills, and thus not only avoid the middleman to get the steel but we will have it cheaper and this will have quite naturally its effect upon the price of the finished products from our factories.

"To produce an automobile farm tractor at such a low cost or price that every

farmer could purchase one, has been one of my ambitions.

"For years I have worked quietly upon the problem, and while some were made and tested long before the ones now in operation upon my farm in Dearborn, I was not satisfied until I had the tractor actually brought up to perfection.

"Months ago we could have announced that we were going to have a Ford tractor, but, just as in the case of the first Ford passenger car, we wanted to be sure of our ground, of our product. Now we are. Now we know that we have the tractor which will do the work, do it well and at such a low cost that it will be only a question of a few years when farmers will be faced with a new problem, that of the disposition of the horse. The tractor will do what five horses have been doing, so you can readily understand that the poor horse will have to look out for itself."

Washington State Derives \$37,500 from New Law

SPOKANE, WASH., June 18—The new motor law in the State of Washington which went into effect on June 10 will bring at least \$37,500 into the state coffers, which was not paid in last year, to say nothing of the large proportion which, operating in the jitney or "for rent" trade, must pay 50 cents per horsepower. As an illustration the Ford machine, with an insurable 23 horsepower, will cost the owner \$11.50 if used for passenger carrying, as against \$2.50 as at present. Of the 15,000 machines in the state which are being operated illegally, fully 6,000 are in the Seattle district but with the new law in effect revenue will be derived from cars which have been running without license of any kind.

The Pacific Coast Casualty Co. has completed its check of the jitney situation and finds a commendable intention on the part of the majority to aid in keeping within the law. Of the 466 jitneys actually in operation in Seattle, but nineteen have been intentional violators of the traffic ordinances and of the bonding agreement. These have been retired as bond risks. Spokane now has forty-one jitneys; Tacoma, seventy-seven; Everett, eighteen, and Bellingham, four.

24,400 Register in Maryland

BALTIMORE, MD., June 19—During the first 5 1-2 months of this year 24,400 automobiles have been registered and it is estimated that by the end of the year there will be more than 30,000 cars registered in this state. In 1914 20,200 cars were registered and \$295,000 taken in registration fees. One of the reasons advanced for the great increase in registration is the improvement in Baltimore streets as well as in state roads.

105 Automobiles for Rural Delivery

Post Office Survey 105 Routes—Delivery in August—May Standardize Vehicles

WASHINGTON, D. C., June 22—One hundred and five routes for automobile delivery have been authorized, delivery to start on same August 2 and there is a strong possibility that in the near future the postoffice department will standardize motor vehicles for delivery. At the beginning the carrier may use any machine with not less than 800 pounds carrying capacity and a cubic load space not less than 80 cubic feet. To date no standards have been issued as to design or postoffice insignia. According to the postoffice department, motor delivery of mails will start on a large scale August 2, when 5,500 miles of rural post roads will be covered daily. This service will be extended as rapidly as possible.

The first dispatch of rural mails by motor car will be made July 1, radiating from Quarryville, Pa. Preparing for the introduction of this service wherever it will be advantageous, surveys of special needs and conditions in every State are being made and the postoffice department says that rapid increase in motor car mileage may be expected during the coming fiscal year.

The routes to be operated include distances of between 50 and 60 miles, and the schedules vary from 6 to 8 hours. In the same or less time than is now required to do 25-mile wagon route the motor car will serve the largely extended territory.

In the revision of the rural service and the inauguration of motor delivery there has been a reduction in operating expenses from April to June 19 of \$744,300. This sum has been utilized to establish 732 new routes to serve 85,472 additional families or nearly half a million people.

Pocket Edition of National Used Car Report

CHICAGO, ILL., June 19—The first number of the pocket edition of the National Used Car Market Report has just been issued by the Chicago Automobile Trade Assn. It is a handy little volume, 3 by 4 3-4, bound in red leather and containing in concise form statistics on 131 gasoline and steam cars and fourteen electrics. As is shown in illustrations on this page, the book covers only one zone; that illustrated is Zone 7, centering in Chicago.

The tables shown give for each car the year, type, list price, number of cylinders, horsepower, appraised value in the

zone, appraised average value for the whole United States and "as is" sales average for the United States. Following the tables are additional data in run-in form, giving the year, model style and list price. The entire data for even such a long-established car as the Pierce-Arrow occupy but one page.

An index at the front enables the user to turn readily to the data desired. Opposite the index is a table explaining the abbreviations used. There is also an explanatory page, telling how to get best results from the book.

The association is gratified at the reception accorded the book; following the deliveries to subscribers to the larger and national report, numerous additional requests were received. If the book is issued to a salesman through a dealer both the dealer and salesman must sign an agreement. The condition attaching to a subscription is that when the next number is received the present number shall be returned, the same rule applying to the national report. This is to restrict service to subscribers.

The books are issued quarterly for \$5 a year. The leather cover is detachable, following numbers being inserted. Each book is numbered and a record kept by Assistant Secretary T. D. Beard at the association offices, 2422 Michigan avenue.

Berry Is Advertising Head

TOLEDO, O., June 21—G. M. Berry has been promoted to the position of advertising manager of the Willys-Overland Co. Mr. Berry was formerly connected with the Thos. B. Jeffery Co. as second vice-president and treasurer and connected himself with the Overland organization 18 months ago.

Tire Issues Continue Rise

Goodyear and Kelly-Springfield Cos. Feature the Security Market

NEW YORK CITY, June 21—Except for the large gains of the tire issues, the security markets were dull and uninteresting during most of last week. Within the last month tire stocks have shown a much higher tendency, in fact, sometimes reaching a record mark.

Last week, though most all of the tire issues made substantial gains, the most prominent were those of Goodyear and Kelly-Springfield. Goodyear common rose 17 points while that of the Kelly-Springfield company rose 13 points. The first and second preferred stocks of the latter company rose 1 1-2 and 20 points respectively, a record gain for the latter stock. Firestone common rose 6 points and Goodrich common 4 points.

The volume of business in the automobile stock market was small, thus reflecting little activity and few gains.

The Detroit quotations were in sympathy with the local prices, the prices there hovering around the opening prices with few important changes.

S. A. Exports Better in May

NEW YORK CITY, June 19—Exports to South America in the last 3 months show a gratifying improvement when compared with the earlier part of the war period. Exports in March were about \$2,000,000 more than in the same month of last year, and April showed another

gain of about \$2,000,000 over April, 1914.

May exports to Argentina from the port of New York included \$163,000 worth of gasoline, \$20,000 in automobiles, and \$68,000 in lubricating oil.

A steamer leaving for Buenos Aires on June 8 carried \$20,000 worth of automobiles.

Franklin Dividend on Common Increased to 40%

SYRACUSE, N. Y., June 19—The H. H. Franklin Mfg. Co. has increased the dividend rate on its common stock from a 6 per cent. to a 10 per cent. quarterly basis, the dividend payable July 1, being at the rate of 40 per cent. per annum.

In addition, the directors have voted to retire as of July 1 the small issue of preferred stock, amounting to \$130,450.

A production of 3,800 cars is being planned for, in addition to 1,000 cars to the 1915 output. To take care of the increase, three new buildings, with 75,000 feet of floor space, are being erected.

Dividends Declared

The Electric Storage Battery Co., Philadelphia, Pa.; 1 per cent. common and preferred.

Willys-Overland Co., Toledo, O.; quarterly 1 3-4 per cent. preferred.

Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.; quarterly of 1 3-4 per cent. preferred and 1 per cent. common.

Yale & Towne Mfg. Co., New York City; quarterly 1 3-4 per cent.

Linde Air Products Co., New York City; quarterly dividends 1 1-2 per cent. preferred and 2 per cent. common.

Automobile Securities Quotations on New York and Detroit Exchanges

	1914		1915		Wk's
	Bid	Asked	Bid	Asked	Ch'ge
Ajax-Grieb Rubber Co. com.	220	..	300	..	..
Ajax-Grieb Rubber Co. pfd.	99	..	101	..	..
Aluminum Castings pfd.	98	100	98	100	..
J. I. Case pfd.	81	90	70	79 1/2	..
Chalmers Motor Co. com.	99	103	92 1/2	95	-2 1/2
Chalmers Motor Co. pfd.	96 1/2	99	95	98 1/2	+4
Electric Storage Battery Co.	51	51 1/2	54	55	+2
Firestone Tire & Rubber Co. com.	300	305	490	495	+6
Firestone Tire & Rubber Co. pfd.	108	109 1/2	110	..	-1
General Motors Co. com.	92	93 1/2	151	153	-1
General Motors Co. pfd.	93	94	101	102 1/2	+1
B. F. Goodrich Co. com.	24 1/2	24 1/2	51	53	+4
B. F. Goodrich Co. pfd.	88 1/2	90	100	103	-1 1/2
Goodyear Tire & Rubber Co. com.	170	175	263	268	+17
Goodyear Tire & Rubber Co. pfd.	97	99	106	107 1/2	+1
Gray & Davis, Inc., pfd.	95	102 1/2	..	..	..
International Motor Co. com.	..	5	13	15	-1 1/2
International Motor Co. pfd.	3	10	34	36	-3
Kelly-Springfield Tire Co. com.	..	..	158	162	+13
Kelly-Springfield Tire Co. 1st pfd.	..	..	86	87	+1 1/2
Kelly-Springfield Tire Co. 2d pfd.	..	..	160	165	+20
Maxwell Motor Co. com.	14 1/2	14 3/4	43	44	-3
Maxwell Motor Co. 1st pfd.	44	46	86	88	..
Maxwell Motor Co. 2d pfd.	18	19	37	38	-1
Miller Rubber Co. com.	..	..	185	187	..
Miller Rubber Co. pfd.	..	..	104	106	..
New Departure Mfg. Co. com.	126	128	..	..	..
New Departure Mfg. Co. pfd.	106 1/2	..	..	..	..
Packard Motor Car Co. com.	103	..	103 1/2	..	+1 1/2
Packard Motor Car Co. pfd.	97	100	96 1/2	99	+ 1/4
Peerless Motor Car Co. com.	18	25	67	70	..
Peerless Motor Car Co. pfd.	..	62 1/2	94	96	..
Portage Rubber Co. com.	..	40	35	39	..
Portage Rubber Co. pfd.	..	90	92	93	..
*Reo Motor Truck Co.	10 1/2	12	14 1/2	15 1/4	+ 1/4
*Reo Motor Car Co.	20	22	32	33	..
Splitdorf Electric Co. pfd.	40	50	..	..	..
Stewart-Warner Speed. Corp. com.	48 1/2	49	68 1/2	69 1/2	+1
Stewart-Warner Speed. Corp. pfd.	98 1/2	99 1/2	105	..	+1
Studebaker Corporation com.	30 1/2	31	75 1/2	77	+ 1/2
Studebaker Corporation pfd.	..	..	..	..	..
Studebaker Corporation pfd.	86 1/2	88 1/2	99	101	..
Swinehart Tire & Rubber Co.	85	87	79	82	..
Texas Co.	143 1/2	144 1/2	124	128	-4
U. S. Rubber Co. com.	58 1/2	59	64	66	-2
U. S. Rubber Co. pfd.	102 1/2	103 1/2	106 1/2	108	-1
Vacuum Oil Co.	221	225	198	202	-3
White Co. pfd.	107	110	103	108	..
Willys-Overland Co. com.	78	79	129	130	-2
Willys-Overland Co. pfd.	93	95	103	105	+1 1/2

*Par value \$10.00; all others \$100.00 par value.

OFFICIAL QUOTATIONS OF THE DETROIT STOCK EXCHANGE

ACTIVE STOCKS					
Chalmers Motor Co. com.....	101	..	92	96	+1
Chalmers Motor Co. pfd.....	95	98	95½	98½	+1
Continental Motor Co. com.....	..	180	175	190	-7½
Continental Motor Co. pfd.....	..	75	..	86	..
General Motors Co. com.....	92½	95	151	155	+1
General Motors Co. pfd.....	92	94	101	103	+1½
Maxwell Motor Co. com.....	14½	15	43	45	-2
Maxwell Motor Co. 1st pfd.....	44	45	86½	88½	+½
Maxwell Motor Co. 2d pfd.....	18	19	37	39	-1½
Packard Motor Car Co. com.....	103	..	103	99	..
Packard Motor Car Co. pfd.....	97	100	96½	99	..
*Reo Motor Car Co.....	18	19	..	32½	-¼
*Reo Motor Truck Co.....	10½	11¾	14½	15½	..
Studebaker Corporation com.....	..	..	76	77½	+½
Studebaker Corporation pfd.....	..	..	100	102	+1
INACTIVE STOCKS					
*Atlas Drop Forge Co.....	..	21	..	26	..
Ford Motor Co. of Canada.....	..	550	1000	..	+50
Kelsey Wheel Co.....	185	..	200	..	..
*W. K. Prudden Co.....	..	20½	19½	21	..
Regal Motor Car Co. pfd.....	20	..	..	25	..
BONDS					
General Motors, notes, 6s, 1915.....	101	102	98½	98½	..
Packard Motor Co. 5s, 1916.....	95	98½	98½	..	..

*Par value \$10.00; all others \$100.00 par value.

The four cars that qualified today were Henning's Mercer Special; Mulford's Mulford Special; Hughes' Porter-Knight and Rawling's Ogren, a post entry that was accepted only after all the drivers consented to the eleventh-hour nomination.

Limberg's Sunbeam, which qualified at a speed of 90.8 miles an hour last week, will not be allowed to start. There are three other Sunbeams in the race, all of which made faster time in the eliminations, and consequently Limberg's amount is automatically barred by the three-car rule of the American Automobile Association.

In addition to Limberg's Sunbeam, the following original entries will not start:

Ralph DePalma's Mercedes; Barney Oldfield's Bugatti; Brown's Du Chesneau; Vail's Mulford Special; Zucher's Berwyn Baby, and Mais' Mais Special. The Mercedes and Bugatti were scratched last week because of mechanical trouble, the Du Chesneau and the Mulford Special failed to make their appearance; the Berwyn Baby was hopelessly slow and the Mais Special is suffering from lubrication troubles.

In an effort to better their starting positions, several of the drivers qualified their cars for a second and third time today and eight succeeded in making faster time than they did in their first laps in the eliminations. The surprise of the day was the showing of the two Maxwells by Rickenbacher and Carlson. Neither appeared exceptionally speedy when it qualified last week but this afternoon they averaged 103 miles an hour or better and earned a place in the second row of starters.

Sunbeams Gain Speed

The two English Sunbeams, entered by the British maker, also had greater speed today than they showed last week, Von Raalte raising his average speed from 93 to 100.8 miles per hour and Porporato hitting 98.66 miles per hour in his third trial. Harry Grant drove some of the bugs out of his six-cylinder motor since last week when his best time was 91 miles per hour and covered a lap at a 96-mile an hour clip this afternoon.

Haupt's Duesenberg has more speed than it had last week and Joe Cooper's Sebring raised its average from 89 to 92.3 miles an hour.

The drivers will have 2 more days of practice before the race. The track will be closed on Friday in order to prepare it for the inaugural contest. The drivers' meeting will be held Thursday night.

Peugeot Fastest

Resta with his Peugeot stands first in the list of the twenty-three to qualify, his average for the two laps being 110.1 miles an hour, and almost 6 miles an hour faster than any of the other cars to qualify.

The most consistent team qualification was that of the three Stutzes, all of which will line up side by side with Resta in the front row Saturday. Naturally the Stutz team is the favorite one as it was at Indianapolis a month ago, and it is expected that considerable race strategy will be exercised by this team in wearing down its speedier rival, Resta. Resta will have to meet the Stutz stamina single-handed Saturday, in that his speed-mate DePalma, who was his fighting rival at Indianapolis, has not been able to get his Mercedes ready. It will not be surprising to see one of the Stutz entries start out setting the pace and as they all qualified at a speed slightly over 104 miles an hour, some fast traveling will be looked for in the early stages of the race. It will only be a question of motor and chassis stamina that will determine the average speed, because drivers are agreed that the 2-mile board track scientifically banked as it is, is much easier to drive than the Indianapolis track with its not so well banked turns. The three Stutz cars have been completely overhauled since the Indianapolis race, and this, backed by the Stutz factory organization, should form a strong combination.

The opinion is common that Porporato and the English Sunbeam will be a factor in the race and much more dangerous than at Indianapolis when the British entry was eliminated near the close of the contest with a faulty carbureter while running well inside the money. The Sunbeam is built for a banked track such as the Chicago one and both Porporato's car and that of Von Raalte have been fitted with the same gears as were used at Brooklands for successful time trials. Porporato is a masterful driver and fearless. Like the majority of foreigners he shows his car no mercy and if the Sunbeam stands up under him he should be a serious contender all the way.

Barney Oldfield established Sunday a new lap record for the wooden bowl. At the wheel of his Christie the veteran covered the 2 miles in 1 minute 42/5 seconds, an average of 115.5 miles an hour.

Chicago's Speedway Field

Car	Driver	Time	M.P.H.
Peugeot	Resta	1:05.4	110.1
Stutz	Wilcox	1:08.7	104.75
Stutz	Anderson	1:08.8	104.6
Stutz	Cooper	1:08.8	104.6
Maxwell	Carlson	1:09.78	103.1
Maxwell	Rickenbacher	1:09.9	103
Peugeot	Burman	1:11.3	101.0
Sunbeam	Von Raalte	1:11.45	100.6
Sunbeam	Porporato	1:12.96	98.6
Delage	Chevrolet	1:14.3	97
Porter-Knight	Keene	1:14.2	96.9
Duesenberg	O'Donnell	1:14.7	96.4
Sunbeam	Grant	1:14.8	96.2
Duesenberg	Alley	1:15.9	95
Mercer Special	Henning	1:16	94.7
Duesenberg	Haupt	1:16.7	93.8
Peugeot	Babcock	1:17	93.2
Sebring	J. Cooper	1:18	92.3
Ogren	Rawling	1:18.30	92
Porter-Knight	Hughes	1:18.98	91.1
Maxwell	Orr	1:20.3	89.6
Porter-Knight	Devore	1:21.3	87.3
Mulford Special	Mulford	1:23.75	85.9

Association to Insure Race Drivers

New Drivers' Assn. Offers 25% of All Revenues for Benefit of Drivers

CHICAGO, ILL., June 19—A movement which is hoped will benefit drivers and mechanics who are injured in races has been started by the Automobile Drivers' Protective Association, organized at Indianapolis during the recent race meet. This association contemplates an insurance fund for the benefit of injured drivers and mechanics.

Twenty-five per cent. of all revenue paid into the treasury of the protective association will be set aside as an insurance fund and held in trust. A nucleus for this fund was created by the management of the Chicago speedway, which is sharing the receipts from practice with the drivers. The local promoters already have turned over \$1,800, which is 40 per cent. of the money taken in at the gate Sunday, to the drivers' association, and \$450 has been deducted from this sum for risk benefits. The remaining \$1,350 will be divided among the teams who warmed up their mounts in order to thrill the Sabbath throng. In addition to money received for participating in practice, 25 per cent. of the initiation fees and annual dues will be put into the insurance fund.

Fifteen Charter Members

The drivers held their first meeting since they organized at Indianapolis here today and adopted a constitution and by-laws. The fifteen charter members of the organization are representative drivers and the board of directors is composed of such stars as Ralph de Palma, Harry Grant, Barney Oldfield, Earl Cooper and Bob Burman. Fifty applications for membership have been received.

The following men have been chosen to guide the destinies of the organization during its first year:

President, L. C. Erbes of St. Paul; first vice-president, E. J. Schroeder of Jersey City, N. J.; second vice-president, Charles Erbstein of Chicago; and secretary-treasurer, E. C. Patterson.

The drivers' association is heartily in sympathy with the American Automobile Association in its efforts to put racing on a high plane in this country and the by-laws stipulate that no driver or mechanic can become a member of the organization unless he is in good standing with the A. A. A. and willing to live up to the rules of the A. A. A. contest board. In addition, each member must post a bond of \$1,000 to abide by the A. A. A. rules.

Five-Car Entries Allowed

A. A. A. Will Register All Racing Cars to Avoid Certain Abuses

NEW YORK, June 22—At a meeting of the Contest Board of the American Automobile Assn. changes in the contest rules were made which will permit of starting five cars of one make in a contest instead of three as formerly. Where five cars are entered, three may be entered as a factory or team entry and the two additional cars may be entered by individuals.

A plan has been adopted to register all racing cars so as to avoid certain abuses now existing and each racing car will be designated as a special model.

Messrs. Sloan & Moross were disqualified for running outlaw meets, the disqualification being for 3 years from date of last unsanctioned contest. Drivers connected with them were disqualified for a period of 1 year from date of their last offense. Drivers re-instated by the board included Hughie Hughes, Arthur Chevrolet, Omar Toft, Herb Alderson, Harry N. Agerter, C. O. Norman, and Charles W. Johnson. Further changes in rules limit the length of a handicap on a 1-mile track to 10 miles.

Sioux City Has 17 Entries

SIoux CITY, IA., June 19—Everything pertaining to the speedway races here on the 2-mile dirt speedway July 3 are moving along satisfactorily and a record attendance is looked for. To date 17 entries have been received.

Car	Driver
Maxwell	Rickenbacher
Maxwell	Carson
Duesenberg	Alley
Duesenberg	O'Donnell
Duesenberg	
Erwin Special	G. C. Bergdoll
Erwin Special	
Du Chesneau	W. W. Brown
Mals Special	J. A. Max
Sebring	J. T. Cooper
White 6	W. J. Shunk
Emden	Grant Donaldson
Peugeot	Resta
Mulford Special	Mulford
National	Butler
Orgen	
Chalmers	H. A. Wetmore

Tacoma Has Big Field

TACOMA, WASH., June 19—Seventeen starters are to date assured for the Tacoma race meet Sunday and Monday July 4 and 5. On the first day will be held one race for 250 miles on the new 2-mile board speedway and on Monday there will be two races one at 100 miles and the other at 200 miles.

Car	Driver
Barney Oldfield	Peugeot
G. E. Ruckstell	Mercer
Harry Reynolds	Marmon
Eddie Pullen	Mercer
Frank Elliott	Gordon
Bob Burman	Peugeot

Earl Cooper	Stutz
Dave Lewis	Stutz
George Hill	Stutz
Jim Parsons	Parsons
Ernest Schneider	Schneider
Ben Hendriks	Stutz
Billy Carlson	Maxwell
Joe Thomas	Mercer
H. D. Stratton	Mercer
Ray Lentz	Romano
T. F. Barsby	Velle

Oldfield will probably drive the Peugeot with which Resta won the Vanderbilt and Grand Prize races. Earl Cooper has entered the third Stutz which will probably be driven by George Hill.

Board Speedway for Coast

CHICAGO, ILL., June 24—Los Angeles, Cal., is to have an automobile speedway and expects to have it completed for opening on Thanksgiving day. L. W. Wickes, engineer in charge, was in this city last week making a study of the 2-mile Chicago track. A. M. Young, prominent in the promotion of southern California racing is the chief backer of the project and claims that options are already held on three sites all within 15 minutes ride by trolley from the center of the city. This enterprise should mark the home-coming of speedway racing for the coast so far as board tracks are concerned as the original board track speedway of America was built on the coast.

Sixteen Entrants for Omaha

OMAHA, NEB., June 21—Arrangements are nearing completion for the 300-mile race on July 5 on the new 1 1-4 mile board speedway in this city. The track was completed a week ago and now a force of workmen is completing the grandstand and other necessary buildings. Entries to date follow:

Car	Driver
Mercedes	De Palma
Duesenberg	O'Donnell
Duesenberg	Alley
Maxwell	Buske
Sunbeam	Forporato
Sunbeam	VonRaalte
Peugeot	Resta
Stutz	Anderson
Stutz	Wilcox
Baby Peugeot	LeCain
DeLage	John DePalma
Maxwell	Rickenbacher
Maxwell	Moore
Du Chesneau	Brown
Mals Special	Mals
F. R. P.	Hughes

Robertson Joins Houk

NEW YORK CITY, June 18—George H. Robertson, prominent in the automobile industry as a race driver, and later connected with the Auto Supply Co., New York City, for years, has become the eastern district manager for the Houk Mfg. Co., Buffalo, N. Y. His headquarters will be at the company's branch at Fifty-eighth street and Broadway.

Chicago-Seattle Record Established

CHICAGO, ILL., June 19—A record of 2,439 miles in elapsed time of 97 hours and 10 minutes, was made recently over the Yellowstone Trail from Chicago to Seattle. The run was made by a series of relays.

West Reduces Fuel Prices

Twin Cities Cut Prices—Milwaukee and Cincinnati Prices Reduced

MINNEAPOLIS, MINN., June 19—Quiet marks the gasoline market in the Twin Cities. After the Standard Oil Co. had reduced gasoline 1 cent and the independents had met the price at 10 1-2 cents per gallon no change has been noted. The leading independent dealers scout the idea of any price fight with the Standard, and they deny any knowledge of a business combination to be effected between the independents. A leading dealer lays the cut in price to over production of gasoline. He said also that the wet weather has had some effect in reducing general motoring and also that the war had reduced export, thus tending to an overplus of stock in the American market. The Standard people said that discovery of new fields was one phase which brought the reduction. W. C. Stohr of the Independent Oil Co., St. Paul, and John Hancock of the Pure Oil Co. in both cities, are authority for the statements as to the reason for the price cut.

Wisconsin Has Lien Law

MADISON, WIS., June 19—A Wisconsin garage lien law has been passed which gives every keeper of a garage a lien upon and power to retain the possession of automobiles for the amount which may be due for care of same until such amount is paid. The law requires that the garagemen shall not exercise his power upon any automobile unless there shall be posted a card stating the charges for storing, such to be easily read a distance of 15 feet by any person entering the garage through the proper entrance.

2-Mile Speedway for Pittsburgh

PITTSBURGH, PA., June 21—The Pittsburgh Speedway Assn. has been formed to build a 2 1-2-mile speedway in this city. It is expected that within a short time the roster of officials will be announced. The capital is \$1,100,000 and the incorporators are: W. J. Phillips, Gen. F. J. Kress, R. D. Ward, N. S. Grubbs, J. F. Lent, J. H. Johnston, W. C. Atkinson, G. A. MacGregor, J. B. Callanan, F. B. Ninness, T. F. Walter, R. Briney, F. F. Jamison, E. N. Hagerling, C. H. Bunting, J. R. Robinson and others.

Three sites are under consideration, all of which are within a radius of 15 miles of Pittsburgh.

\$35,000,000 for Cars This Year

Southern California to Spend This Amount—68,200 Cars Now Registered

By A. G. WADDELL

LOS ANGELES, CAL., June 19—Southern California, with an approximate area equal to that of the state of Pennsylvania, finds ready means of continuing her lead in per capita purchases of motor vehicles throughout the summer and fall months. It is estimated that out of the \$244,583,311, total products of the eight southernmost counties of California this year, at least \$25,000,000 will be turned into the automobile industry, for new cars. Many experts claim that southern California will invest \$35,000,000 in new machines this season.

Exceptional grain crops are assured by a large and unusually favorable rainfall; improved conditions cause greater demands in the petroleum industry; mining interests are extending; modern highways are giving increased mileage; manufactures are growing in variety and extent; shipping and ship building have attained new proportions and, among many miscellaneous interests, motion picture producing companies are maintaining motor plants of immense importance to the automobile trade of southern California.

\$2,000,000 in Pictures

Moving picture concerns in and around Los Angeles, are using automobiles and motor trucks to the amount of \$2,000,000. One company is represented by 300 machines, owned by the company and the players personally to the value of \$500,000. Many cars are rented by the day or week for the players, but those required for general services are owned and operated by the producing companies. Machines bought by these concerns for wrecking purposes in scenes, afford used-car dealers of Los Angeles a regular line of business, at prices ranging from \$200 to \$300 per car.

Orange growers, ranchmen and farmers generally are now buying cars and trucks as essential adjuncts of their business, each year's crop bringing in new files of purchasers. Each mile of laterals added to the good roads system of the Southland provides new motor vehicle users. And these ranchers and orange growers seek quality in all lines, their cars averaging \$1,250 each.

The state of California as a whole keeps something like \$150,000,000 invested in machines, of which 134,970 are registered on this date. Averaging each car as valued at \$1,000, the investment

represented by machines at this time is approximately \$135,000,000 and according to state and county officials, \$1,000 per car in California is a low estimate.

There are 68,200 machines registered from the southern California counties alone. The southern California branch of the state motor vehicle department records shows a total registration from the eight southern California counties at this time last year amounting to 51,369 cars, an increase in 1915 of 16,831 cars, practically all new machines. At this time last year Los Angeles county had 35,132 registrations; Imperial, 1,270; Orange, 3,138; Riverside, 1,743; San Bernardino, 2,686; San Diego, 4,713; Santa Barbara, 1,486, and Ventura, 1,201.

The Products of Southern California

The eight southernmost counties of California, all of which are tributary to the port of Los Angeles will produce approximately \$250,000,000 this year, of which at least 10 per cent. will go direct to the coffers of the automobile industry, according to authoritative and conservative figures.

Product	Quantity	Value.
*Asphaltum	200,000 tons.	\$1,600,000
*Beans	1,665,000 bags	6,573,750
*Beer	300,000 bbls.	2,400,000
Berries	425,000 crts.	425,000
*Borax .....	.....	500,000
*Brick .....	.....	1,698,500
Butter	7,525,200 lbs.	2,077,716
Cabbage	500 c. l.	125,000
Canned goods.....	1,750,000 cases	3,500,000
Cauliflower	600 c. l.	150,000
Celery	1,500 c. l.	375,000
*Cement	4,000,000 bbls.	5,750,000
Cheese	250,650 bbls.	39,577
Clay .....	.....	137,000
Copper .....	.....	320,000
*Cotton	60,000 bales	3,000,000
Eggs	300,000 cases	2,760,000
Fertilizer .....	.....	1,500,000
*Fish, canned	300,000 cases	2,000,000
Fish, fresh.....	34,000,000 lbs.	2,089,200
*Flour and flour mill products.....	1,000,000 bbls.	5,000,000
*Fruits, citrus	41,978 cars.	33,000,000
*Fruit, dried	8,000 tons.	1,110,000
Gems .....	.....	15,000
Gold .....	.....	374,000
*Grain	5,500,000 bu.	3,700,000
Gypsum .....	.....	65,000
*Hay	350,000 tons.	4,000,000
Hides .....	.....	2,500,000
*Honey	5,000,000 lbs.	250,000
Lettuce	300 c. l.	90,000
Lime	1,000 bbls.	125,000
Limestone .....	.....	217,000
*Lumber and timber imp't'd rough and milled.....	180,000,000 ft.	5,760,000
*Meats, dressed .....	.....	20,000,000
Melons	5,000 cars.	1,500,000
Mineral waters .....	.....	40,000
*Nuts	8,300 tons.	3,000,000
Olive oil	105,000 gals.	325,000
*Olives, pickled.....	.....	1,000,000
Onions	250 c. l.	75,000
*Petroleum	100,501,000 bbls.	46,783,568
*Peppers and pimientos .....	.....	550,000
Potatoes	800 c. l.	240,000
Potatoes, sweet.....	100 c. l.	40,000
Poultry .....	.....	1,400,000
*Salt	25,000 tons.	117,500
Stone, crushed and gravel .....	.....	2,420,000
*Sugar (beet)	160,000 tons.	16,000,000
Tomatoes	200 c. l.	90,000
Vegetables, asstd.....	1,500 c. l.	525,000
*Wines and brandy.....	6,500,000 gals.	2,750,000
Wool .....	.....	500,000
*Manufact'd products not mentioned herein .....	.....	54,000,000
		\$244,583,311

*Suited for export.

A year ago the total car registration in the state amounted to 102,148 machines over which the total 1915 registrations to date show an increase of 32,822 cars. This increase represents new cars almost entirely and represents not less than \$30,000,000 spent for machines in California already this season, according to the most conservative figures of bankers and state officials.

There were 949 new machines sold out of Los Angeles territory during the month of May exclusive of Fords, and the machines shipped into Arizona, which territory is controlled almost exclusively by Los Angeles dealers. On an average of 200 Fords a month are sold in southern California and from 50 to 100 go into Arizona, which do not show on the California registration reports.

Money is abundant in the banks of this region, though conservatively handled. On May 18, the date of the last call, the banks of Los Angeles city carried total deposits of \$171,257,628 with \$47,085,583 cash on hand. The Los Angeles clearing house reports that these sums are not decreasing as the season advances, but increasing.

Eight counties of southern California produce this year approximately \$250,000,000 in crops and staple manufactures. Petroleum alone yields \$46,000,000 of which \$5,000,000 is estimated as the current investment due for motor cars. Trucks and cars for use of owners and operators, as well as private machines for the well paid workers in the oil fields, swell this demand from the oil centers.

Some Leaders

Citrus fruit, second in importance as an item of revenue, amounts this year to 41,978 cars, of \$33,000,000 in value. Dressed meats come to \$20,000,000 and rank third with beet sugar amounting to 160,000 tons estimated at \$16,000,000 in value. Beans are yielding 1,665,000 bags, bringing a further \$6,573,750 at the lowest estimate. The acreage is greatly increased over all former years by planting throughout orchards in some localities. Walnuts are developing a magnificent crop and melons are apparently due to break all records. The 7,650 acres of canteloupes in Imperial Valley alone are estimated at 1,500,000 crates worth \$1,500,000.

The ports along the west coast of Mexico are stocked with hides and Mexican products and the traders of that section are anxious to do business with the shippers of the Pacific Coast, San Diego and Los Angeles, in particular. This is a new field and Los Angeles harbor has already been taxed with the Mexican export and import business.

Against these advantages must be considered the general depression felt more or less throughout the country, the un-

favorable effects of the present tariff on citrus fruit and other commodities, and the loss of European buyers because of war—particularly the cutting off of Germany as a buyer of apricots. Apricots of the finest quality, in large quantities, are expected to bring less than 5 cents per pound, by reason of the decreased foreign markets.

As the birthplace of the jitney bus, Los Angeles furnishes records effecting the tremendous issues involved in this new factor of municipal and commercial life which are worthy of especial attention. The jitney cars, lately used so freely in passenger transportation, have reduced the street car traffic to such a point that the state of California is losing \$200,000 annually on its share of the gross revenue of the car companies. This serious loss induced the Legislature to enact a law taxing each vehicle engaged in motor transportation of passengers at the rate of \$7.50 per annum for each passenger seat. This bill, now in the hands of the governor, will doubtless become effective, if for no other reason than the necessity of maintaining the state revenues.

1,000 Jitney Buses

Los Angeles at one time supported 1,800 licensed jitney busses, with 1,000 in daily operation. At the present time less than 1,000 licenses are effective, with 500 in constant operation. This level has been maintained for the past 6 months and seems fairly indicative of an established market for such vehicles, if the same conditions continue.

But the increase of motor accidents, as well as the opposition to this traffic developed from various sources, and the necessity of controlling the business in some measure, impelled the city to establish regulations in the shape of a license tax of \$2.50 per seat per month, bonds of \$5,000 for each vehicle, adherence to routes specified, licensed chauffeurs, etc. Such an ordinance was passed in February, but was held up by the jitney owners, who secured an initiative petition under which a much less burdensome ordinance, requiring no bond whatever, was submitted to the voters. The substitute ordinance having just been defeated at the polls by 11,000 majority, the council's ordinance now becomes law; and the new council, elected at the same time, even shows a disposition to increase the bond required to \$10,000 or \$15,000.

The Accident List

Fifty per cent. increase in motor accidents with the advent of the jitney, as shown by the records of the Los Angeles police department, induces the requirement of bonds adequate to the protection of the public. From 400 accidents per month involving motor vehicles prior to the advent of the jitney service, 600 has become the regular average.

Discovers Rubber Substitute

Dr. Noble of Cleveland, Discoverer—Coal Tar Chief Ingredient of Product

CLEVELAND, O., June 18—Dr. Lyman A. Noble, electro-therapist, of 810 Schofield Bldg., this city, claims to have discovered a substitute, combining all the qualities of natural rubber. He states that the chief ingredient of his product is coal tar.

Mr. Noble has been experimenting for nearly a year. His first experiments failed because the resulting product was greatly lacking in resiliency. This he found was solely a matter of process, and the use of a high frequency, high voltage electric current has eliminated the difficulties. By evaporating the liquid combination of ingredients and submitting them to a high frequency current for an extended time, 6 hours, the result was attained.

From 200,000 to 500,000 volts of electricity of high frequency was necessary to produce the rubber. The various ingredients are mixed, by secret formula, into a liquid which, under heat, is evaporated down to one-quarter of its original mass. When it has reached a consistency of a thick syrup, the mass is placed in a metal retort and connected with a high frequency electrical machine. The retort forms one pole and the other pole is suspended in the liquid. The current is turned on and after 6 hours, the

During the four months from December 1 to April 1, Los Angeles recorded 2,300 accidents to motors, of which 1,473 were private machines, and 827 jitneys. This was while 28,000 private machines were in use, and 500 jitneys on the streets.

To Reduce Number

These accidents naturally furnish some consumption of machines, besides the wear of the unusually heavy traffic on the light cars commonly used in the service. The municipal and state legislation mentioned will doubtless tend to reduce the number of cars used for this purpose, but on the whole, the jitney service may be looked upon as a new, large and lasting addition to the automobile trade of southern California.

Ore refineries and mills in process of erection near Los Angeles harbor are planning employment for many additional workers within the year and their combined enterprises should introduce an appreciable element into local automobile distribution.

retort contains a black, spongy substance with all the qualities, Dr. Noble claims, of natural rubber.

The inventor claims that with the artificial rubber the cost of a 37 by 5-inch tire will not cost more than \$15 a tire, or \$60 for a set of four.

He stated that a company is being organized to manufacture his product on a large scale, and a plant will be built in Cleveland.

Wayne Tank Gets Extension

CHICAGO, ILL., June 19—The Wayne Oil and Tank Co., Fort Wayne, Ind., defendant in a suit brought against it in the United States district court of the northern district of Illinois, eastern division, by S. F. Bowser & Co., of Fort Wayne, charging three infringements of patents now held by the latter concern relating to improvements in filling and vent-filling devices used in gasoline storage and dispensing systems, has been granted a further extension of 30 days for filing answer to the complaint. This is the second extension, the first being by stipulation April 27, last, when the Wayne company was given 45 days extension beyond the time fixed by the rules of the court.

Jitneys in San Antonio

SAN ANTONIO, TEXAS, June 19—The Jitney Transportation Co. has been organized here with a capital stock of \$150,000 for the purpose of operating jitney buses over regular routes and on regular schedules in this city. Twelve trunk bus lines will be maintained. The incorporators are: L. M. Emlet, W. T. Crow, John Neidert, C. M. Dewey and William Haensler.

Detroit S. A. E. Gets \$2,200

DETROIT, MICH., June 19—The maintenance fund of the Detroit section, Society of Automobile Engineers, was increased by \$350 during the month starting May 15 to June 15. The new contributors were the Timken-Detroit Axle Co., \$200; Saxon Motor Co., \$100; and the Russel Motor Axle Co., \$50. The total amount thus far contributed is \$2,200. The maximum budget for the next 12 months calls for \$2,500.

King Manager Goes West

DETROIT, MICH., June 21—W. L. Daly, sales manager of the King Motor Car Co., has started on a trip through the West, visiting King dealers and distributors.

75,000 Buicks for 1916

DETROIT, MICH., June 18—Instead of 60,000 Buick cars it is reported that the Buick Motor Co. has decided to make at least 75,000 cars for next season.

Factory Miscellany

Galion to Add—The Galion Motor Car Co., Galion, O., is contemplating the erection of a large addition to its factory.

Toledo Ford Tire Adds—The Toledo Ford Tire Co., Findlay, O., will build a two-story factory addition, 50 by 150 feet.

To Make Engines—The Pirate Motor Mfg. Co., 834 Muskego avenue, Milwaukee, Wis., will shortly engage in the manufacture of gasoline engines.

To Make Sheet-Iron Bodies—Frank Doering, Temple, Tex., is erecting a plant and car shop for the manufacture of sheet-iron bodies for automobiles.

Continental Adds—The Continental Motor Mfg. Co., Muskegon, Mich., is erecting a three-story addition to be used for a crating and packing room.

Mercer To Add—A contract for the erection of a one-story, 60 by 400-foot addition to the plant of the Mercer Automobile Co., Trenton, N. J., has been awarded.

Auto Specialty Builds—The Auto Specialty & Equipment Co., 5966 Jackson avenue, Long Island City, N. Y., is erecting a five-story plant, 50 by 96 feet, to cost \$50,000.

Aurora Spark Plug's Plant—The Aurora Non-Fouling Spark Plug Co., Lynn, Mass., has started the construction of a one-story, 50 by 78 feet factory on Chestnut avenue.

Saurer Plant Addition—The International Motor Co., Plainfield, N. J., will enlarge its Saurer plant by building a one-story, 120 by 120-foot machine shop and a one-story, 40 by 60-foot power house.

Russell Axle Commences Addition—The Russell Motor Axle Co., Detroit, Mich., has commenced the construction of a building, 120 by 120 feet, adjoining its present plant.

Tire Inflator Co.'s Plant—The D. L. Davis Co., Ft. Madison, Ia., manufacturer of tire inflators, has acquired a site in that city on which a factory will be erected. The plant site includes 8 acres of land.

Aluminum Cos. Consolidate—The Aluminum Specialties Co., Manitowoc, Wis., has purchased the business, equipment, stock and materials of the Mauston Aluminum Co., Mauston, Wis., and will consolidate the works at Manitowoc.

To Add Tire Manufacture—The Alliance Rubber Co., of Alliance, O., which has been making automobile tires on contract for some time, will soon start the tire manufacturing business in earnest. It is planned to employ three shifts of men after June 1. New equipment will be installed at once to take care of the work.

To Manufacture Fire Apparatus—The Thomas Automatic Fire Engine Co. has been incorporated with a capital of \$100,000 to operate a plant in Columbus, O., for the manufacture of a motor-driven fire engine, the invention of J. A. Thomas, formerly of Zanesville. The engine mixes soda with water, which is claimed to speedily blanket a fire.

To Make Brass Articles—The Klipper Mfg. Co. has been organized at Beaver Dam, Wis., by R. P. Scholz and N. Schweiger to take over the business of the E. O. Siedschlag Co., manufacturing

various articles in brass, bronze and aluminum. E. O. Siedschlag has sold his entire interest to Messrs. Scholz and Schweiger and will retire.

McGraw Tire's Big Generator—The McGraw Tire & Rubber Co., East Palestine, O., has added a new steam turbine and a generator. The latter is built to provide 500 kilowatts an hour, with a 250-volt current and 750 horsepower. The generator will be used to run nine new motors, which will in turn drive several mills and a refiner.

New Era Makes Change—The New Era Spring & Specialty Co., Detroit, Mich., states that all mail matter pertaining to its shock absorbers should now be addressed to the Detroit office, from which point all shipments of shock absorbers are being made, instead of from Hempstead, L. I. Arrangement for their manufacture at that point has been ordered forwarded on to the Detroit office.

To Make Mechanical Starter—The Eureka Mechanical Starter Co., Columbus, O., which was incorporated some time ago with an authorized capital of \$30,000 will soon open a factory in Columbus for the manufacture of a starter, which has been patented. W. A. Ross is in charge of the project. The other incorporators are J. W. Matthews, C. E. Bonebrake, A. Bunford and C. E. Ross.

Milwaukee Parts Co. Moves—The Auto Parts Mfg. Co., Milwaukee, Wis., manufacturer of windshields, bumpers, shock absorbers and other accessories, has moved from the Stroh industrial building to the Milwaukee branch house of the Mitchell Automobile Co., at 528-532 Broadway.

The Automobile Calendar

June 26.....Chicago, Ill., 500 - Mile Race, Chicago Speedway.
 July 3.....Utica, N. Y., Hill Climb, Automobile Club of Utica.
 July 3.....Sioux City, Ia., 300-Mile Race, Sioux City Speedway Assn.
 July 4.....Visalia, Cal., Road Race; Tulare County Automobile Assn.
 July 4-5.....Tacoma, Wash., Road Race, Tacoma Speedway Assn.
 July 5.....Omaha, Neb., Speedway Races, Omaha Motor Speedway.
 July 5.....Visalia, Cal., Road Race, Tulare Co. Auto. Assn.
 July 7-8.....Taylor, Texas, Track Race, Taylor Automobile Club.
 July 9.....Burlington, Ia., 100-Mile Track Race; Tri-State Fair.
 Aug.....Milwaukee, Wis., Independent Petroleum Marketers' Assn. of the U. S.; 1915 Convention in Milwaukee.

Aug. 2-3.....San Francisco, Cal., Tri-State Good Roads Assn., Third Annual Convention.
 Aug. 20-21.....Elgin, Ill., Road Races.
 Sept.....Indianapolis, Ind., Fall Show, Indiana State Fair.
 Sept.....Peoria, Ill., Second Northwestern Road Congress.
 Sept. 6.....Providence, R. I., Speedway Race; F. E. Perkins.
 Sept. 6.....Detroit, Mich., Speedway Race; Detroit Speedway Club.
 Sept. 8-11.....Hamline, Minn., 2-Day Meet at State Fair Grounds between Minneapolis and St. Paul, State Fair.
 Sept. 13.....Oakland, Cal., Pan-American Road Congress.
 Sept. 17-18.....Peoria, Ill., Illinois Garage Owners' Assn. Convention.
 Sept. 20-25.....San Francisco, Cal., International Engineering Congress.

Oct.....St. Louis, Mo., Show, Forest Park Highlands, St. Louis Automobile Manufacturers and Dealers' Assn.
 Oct. 1.....Minneapolis, Minn., Track Race, Twin City Motor Speedway Co.
 Oct. 1-2.....Trenton, N. J., Track Races; Inter-State Fair.
 Oct. 2.....New York City, Sheepshead Bay Motor Speedway Track Meet.
 Oct. 6-16.....New York City, Ninth Electrical Exposition and Motor Show at Grand Central Palace.
 Oct. 11-12.....Dayton, O., National Paving Brick Manufacturers' Assn., Annual Meeting.
 Nov. 18.....Arizona 150-mile Grand Prix.
 Dec. 31.....New York City, Show; Grand Central Palace.
 Jan. 22, 1916.....Chicago, Ill., Show; Coliseum.
 March 4-11.....Boston, Mass., Truck Show, Mechanics Bldg.

The Week in the Industry



Norwalk Resigns.—A. B. Norwalk, formerly the president and a director of the Thirty-five Per Cent. Automobile Supply Co., New York City, is no longer connected with this company in any capacity.

Parrish Heads New Packard Branch.—W. J. Parrish is the head of the new Packard branch in St. Louis, Mo., under the name of the Packard Motor Sales Co., which bought out the Halsey Automobile Co. and which will control all Packard business in the State of Missouri. The St. Louis firm will be known as the Packard Missouri Motor Co.

Recent Changes in Taximeter Co.—Eben Luther has been put in charge of the Boston, Mass., sales department of the American Taximeter Co., New York City. E. E. Smith is in charge of the Philadelphia branch with headquarters at 1209 Vine street. F. C. Copeland is assistant manager of the sales of the Pacific Coast branch in San Francisco, Cal.

Motor Men in New Roles

Howard Houston Detroit Mgr.—D. M. Howard is manager of the newly established Detroit agency in Houston, Tex. The sales rooms are at 116 Main street.

Senour Goodyear's Salt Lake Mgr.—P. W. Senour has been appointed manager of the Salt Lake City branch of the Goodyear Tire & Rubber Co. Formerly he was manager of the El Paso branch.

Haydenfeldt Knox Rep.—Herman Haydenfeldt, formerly connected with the H. O. Harrison Co. as district representative, has been appointed factory representative of the reorganized Knox Motors Co.

Rhodes Joins New Era Spring.—H. P. Rhodes, formerly manager of the Cleveland Spring Co., Cleveland, O., has become Southern general traveling representative for the New Era Spring & Specialty Co., Detroit, Mich., and in charge of its spring business.

Arthur Heads Minneapolis Branch.—The Tri-State Auto Co., 18 University avenue, S. E., has opened a West Side branch on automobile row, at Hennepin avenue and Thirteenth street, Minneapolis, Minn. It is in charge of B. D. Arthur, the company's manager. The Moon and Inter-State cars are displayed.

Henshaw Increases Force.—The Henshaw Motor Co. has recently leased additional space in the Motor Mart Bldg., Park Square, Boston, as part of its service station, and has added several well-known men in the trade to its organization. These include Dearborn Bailey, who joins the sales force. He was formerly with the General Vehicle Co. for 4 years. L. E. Owen, who takes charge of the stock department, after 9 years in a similar position with The White Co. L. C. Hale, with the Maxwell factory for 5 years, becomes chief accountant, while F. P. Kent, who managed a garage in Ipswich, Mass., looks after the testing department.

40-50 Cubic Inch Cylinders

(Continued from page 1109)

and 5 by 7 inches; the weights of these cars he gave respectively 4,200, 5,100 and 5,600 pounds and the miles per gallon as respectively 11, 9 and 8, these figures being reached after a trip of 1000 miles on rough roads. According to Mr. Fergusson recent statements should lead him to believe that the largest is the sweetest running motor of the three.

Mr. Fergusson mentioned a test where a standard 1-ton truck equipped with a 7 to 1 reduction averaged 7.25 miles per gallon and another truck of the same capacity was run over the same roads, equipped with a high-speed type motor geared 14 to 1 and only made 6.6 miles per gallon. Mr. Fergusson concluded by asking why the eight is not used for trucks since economy is so much to be desired.

A. L. Clayden, engineering editor of THE AUTOMOBILE, pointed out that Mr. Fergusson was not quite correct as to gear ratios. He said that the small French and British engines are now geared between 3.5 and 3.7 to 1 and even so low as the 4 to 1, but never 5 to 1, used on American cars. "Driving with these cars," he said, "is of the same effect as driving on the third and not the fourth speed of the European car, but the European car does a large proportion of its running on its lower speeds, whereas the American car runs on the high gear practically all the time, which influences the average motor speed."

D. McCall White, engineer of the Cadillac company, said, "We are all engineers and if we work with principles which cannot go wrong we will be sure to obtain the proper results. In the Cadillac eight-cylinder engine, we have a speed range of from 100 to 3,400 r.p.m. I would like to answer the question as to what is a high-speed engine and believe this is answered by referring to the comparative standard speeds. I have attained 4,000 r.p.m. with an L-head type of motor.

"Although our car, Cadillac eight, has shown good power,

we have not gone after power, the primary attention being placed upon evenness of torque and smoothness."

Mr. White remarked that increasing the number of cylinders increases the wall area and the small four should be developed. An eight must be of the highest type of construction to be a success. In manufacture great attention must be given to minute details, and hence the eight to be correct is expensive to manufacture. He expressed himself as deprecating the rush towards cheaper eights and also stated that the maximum efficiency was not to be secured from the six or twelve. As regards quietness, he said that this quality would be best found in the L-head motor.

F. E. Moscovics referred to Mr. Brush's paper, asking regarding the horizontal vibrating stresses as mentioned in the paper where the author states:

"In this connection it has been interesting to observe that a properly constructed chassis seems much better able to absorb this horizontal vibratory tendency than the vertical vibratory tendency of the vertical four."

He stated that he believed the horizontal stresses to be the most difficult to handle because in the vertical they can be absorbed by the front springs.

Mr. Clayden added that much could be determined by locating the center of gravity and then laying out the points of support of the motor.

William Stout, engineer of the Scripps-Booth Company, remarked that Newton's law, which states that the area of surfaces increases with two dimensions and the volumes or weights with three, could be applied throughout the entire chassis design. A 6-inch piston, he cited, "will weigh a certain amount, while a 3-inch piston will only weigh 1-8 of that. This law applies throughout the whole question of design in laying out a chassis."

Howard Coffin, engineer of the Hudson company, said: "One of my jobs around the Hudson plant is to sit upon the theoretical lid. As one man says, an engineer is all right so long as he does not get into the way of the production and sales departments. The company will vote thousands of dollars for expensive sales campaigns and when the experimental department timidly asks for a few hundred dollars more from the annual appropriation there is immediately a clamor protesting against the wasteful expenditure. The public, however, will not be long misled. Some of the large concerns who advertised themselves as being against the recent developments in motors have reversed themselves completely. Why the eight came is common knowledge.

Multi-Cylinder Work Requires Care

"Behind the cylinder question there are several fundamentals to be taken into consideration. Does a concern expect to charge the public for the work on the multi-cylinder car or give the best value for the money?"

Mr. Coffin then went on to mention how certain exhibits at recent shows were so hurriedly put together that the pistons were not even in the cylinders. He then cited an article which recently appeared in *THE AUTOMOBILE*, where it was stated that the question is not so much how many cylinders as what should be the size of the individual cylinder. He stated it as his belief that the best size per cylinder would be from 45 to 50 cubic inches. From this premise he drew the conclusion that if the piston displacement of the motor were 300 cubic inches or greater it would be better to break it up into a larger number of cylinders. "But we believe that if the piston displacement is less than 300 cubic inches it should not be broken up into more than six cylinders. Mr. White spoke a true word when he deprecated the building of the cheap eight. We believe, however, that the Cadillac eight is carefully made. Some one must pay for the carelessly assembled cars, and it is sure to be the consumer. The Hudson company has built everything up to a twelve and all performed well and each had individualities of its own. So would the repair bills and upkeep expense of each have an individuality of its own.

"The manufacturer must decide the class of people to whom he wishes to cater and must also consider the cost of maintenance. I think Mr. Brush's 2.5-inch limit is too small, as this would only have a 20 or 25 inch piston displacement per cylinder and therefore could not be economical.

Do Not Be Stamped

"I simply want to go on record with a warning not to be stamped by the action of individual engineers. The consumers or prospective consumers have not asked us for the eight-cylinder engine. They would have thought you crazy if you had suggested a year ago that you could supply them with such a power plant for practical use. All this development has been cooked up within our own ranks. There has been no outside demand. You have heard a great many statements regarding the advantages of more than six cylinders as compared to fewer cylinders, but the real result will be that the motors with four and six cylinders will be perfected. The six will be made to perform as well as the eight or twelve. Whenever you say 3,000 r.p.m. is not practical on the six it is merely because we have not learned to build six-cylinder crankshafts. It was the advent of the six that caused so many of the improvements in the four."

Mr. Coffin then remarked that statements have been made that with high-speed engines of equal piston displacement vibration is avoided in the eight and twelve. "I think," he continued, "that if large engines are to be built, because of the weight of reciprocating parts, the bore will have to be limited due to the vibrations set up. Below 3.5 inches this does not hold. It is with these practical limitations that we

as engineers, who must market the cars and secure the maximum results, are concerned."

Howard Marmon, of the Marmon company, believed the higher bore limit could be 4 inches without difficulty, stating as a near example the six-cylinder 3.75 by 4 inches as what he considered good practice.

"Regarding the motors with a greater number of cylinders," said Mr. Marmon, "after going at any speed the purchaser will not know if the motor is a six, eight or twelve. Muffler vibrations are set up even in a six and this is one of the difficulties which may confront the twelve.

"The valve-in-head motor is easier to cool than the L-head or the T-head—the valve location gives a smoother flow to the inlet gases. Our experience also teaches us that the cross vibrations are more pronounced with the eight than they are with the four."

George Dunham, consulting engineer, said: "Mr. White has upset my calculations on what is the right car. I believe that the best car is the one from which the ultimate consumer will secure the best results. The things which sell a car are, first, appearance which attracts the interest of the intending purchaser and, second, performance which makes him decide. Assuming this contention, the motor which gives the best performance would be the best. This condition will react back to fewer cylinder cars. We are apt to think of the four as a heavy motor which is larger and is troubled by vibration. Progress has been made during the last few months due to the multi-cylinder motors, and on these the greatest argument in their favor is the greater number of impulses or, in other words, smoother torque. Smoothness of operation resolves itself down to a question of impulses per unit of travel."

Packard Favors 33 to 40 Inches

Russell Huff, consulting engineer of the Packard company, asked: Why are we all studying the multi-cylinder type of engine and discussing its merits? Asking myself this, it came to me that the problem should be studied by first making the car and then studying its performance. Packard has studied cars for fast cross-country running. We cannot make that type of car under 4,500 pounds even with the best of materials and with this weight a good-sized motor must be used. We have come to the conclusion that 35 to 40 cubic inches piston displacement to a cylinder is the most practical limit. You need 410 to 425 cubic inches to handle the type of car that I have described.

"The public has demanded smoothness. People do not like to shift gears, and this has driven us to study the multi-cylinder type and we have learned many things. The question of reducing the weights of the reciprocating parts should be given great attention. By using a light-weight piston we have made a big cut in the weight on this new Packard twelve and in the connecting rods a similar reduction has taken place. This has enabled us to make vibration practically nothing, while on the six cylinder car at certain speeds there is a vibration. We are now using gear reductions of 4.375 to 1 for fairly level country and 4.75 to 1 for more hilly country and with the new type of car find that we can get 99 per cent. travel without gear changing.

"The valve weight with the new design has been cut from 15.5 to 9.5 ounces and it is our experience that the twelve runs much cooler than the four or six and hence the valve trouble is cut down. Therefore, there will be small necessity for grinding the valves.

"Another feature is the great increase in horsepower output, allowing us to dispense with more models and with this single model do the work of the larger designs. The twin-six performs better than our 48. The magnesium pistons reduce friction, there is better cooling and less power loss, giving better economy than the 38, which is a smaller six. This refutes Mr. Fergusson's statement on the efficiency. The twelve is the easiest motor ever built for carburetion."

Engineering
Library

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JUN 26 1915

AUTOMOBILE

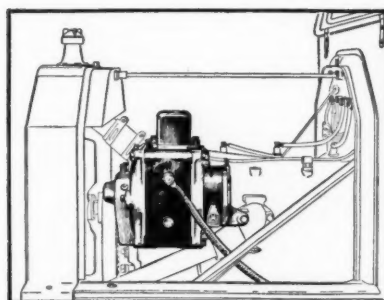
Vol. XXXII
No. 25

NEW YORK, JUNE 24, 1915

Ten cents a copy
Three dollars a year

—to those interested
in Ford cars

either as owners, prospective
owners, agents, or supply dealers



GRAY & DAVIS
System for Ford cars
\$75

THE GRAY & DAVIS Starting-Lighting System is in actual use on over 200,000 automobiles.

It is not a "theory" or a "new" untried device, which may or may not give satisfactory service.

The performance of GRAY & DAVIS equipment is an open book to any motorist. The efficiency of the system is recognized wherever automobiles are driven.

Consider that the GRAY & DAVIS system is used on cars costing as high as \$7,000. Consider also, that it is standard equipment on thirteen different makes of 1915 automobiles.

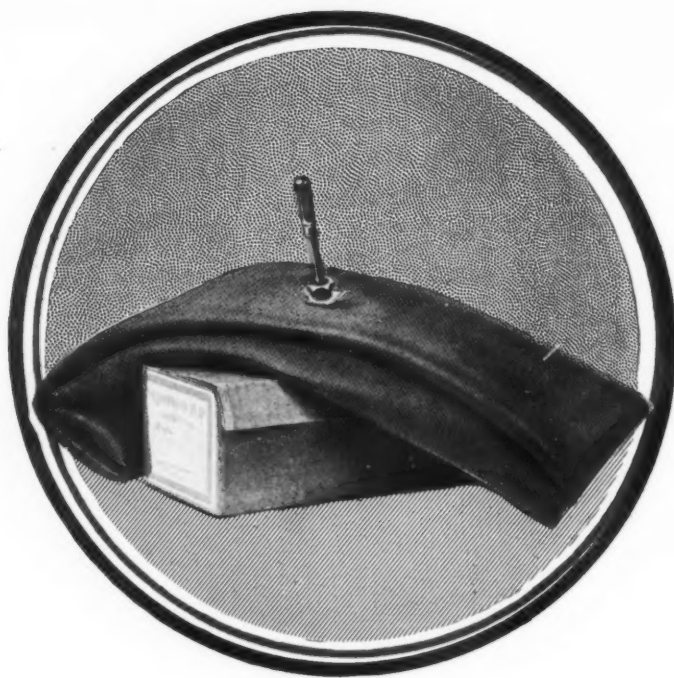
Then realize that the FORD owner, for an expenditure of \$75, can obtain a GRAY & DAVIS system—"GRAY & DAVIS" throughout—design, material and performance.

Is it any wonder that FORD owners are calling for these systems as fast as we can build them?

Send for catalog

GRAY & DAVIS, Inc.

BOSTON, MASS.



Before You Buy Another Tube— Think This Over

More tires are ruined through the use of cheap, faulty tubes than through any other cause.

We know. We make tires and consequently we make adjustments, and nine times out of ten when examining a ruined tire we find that a cheap porous tube was the actual cause of the damage.

The Reason

The best tire in the world will break down and rim cut if it is not kept properly inflated. This is because the fabric in an insufficiently inflated tire is being constantly subjected to an abnormal breaking strain which eventually causes the layers, which compose the carcass, first to crease—then to break and—then to blow out. When a tire is at all soft and inclined to "give" when it strikes a bump, the strain on the fabric becomes terrific. It can't stretch, consequently it must give.

Cheap Tubes Are Not Cheap

It is impossible to keep even a good tire properly inflated if it contains a cheap, faulty

inner tube. For ordinary cheap, machine-made tubes are porous. They leak. They are made of but one thick sheet of rubber rolled on a tube and then vulcanized, which leaves all the tiny air pockets and bubbles and flaws especially inherent to cheap rubber in the tube. You can't see them, but they are there just the same.

And although you may start on a trip with tires properly inflated they *slow leak*. They leak *through* the rubber and around the valve base. They require inflating often else the shoes are quickly ruined.

National Special tubes are made of the finest selected rubber stock money can buy—Upriver Para. We could compound ordinary good rubber for 1/3 the price we pay for this selected stock. Then when we build the tube we build it of many thin layers—not of one solid sheet. Each layer is rigorously inspected as it is applied in order that flaws, if any, may be detected and removed. Each layer is applied under ten tons of pressure. Then the tube is built *thick*—thicker than any other tube you have ever seen.

It takes time and money to make tubes in this way but the results obtained are well worth the added cost, for these tubes are non-porous and are so guaranteed. They *stay* inflated. They are proof against deterioration. They have from three to five times the life of ordinary machine-made tubes.

Think This Over

Before you buy another cheap tube think of more than the initial price. Consider how long it will wear. Will it be a constant source of annoyance and endanger the life of your tires—the *real* item of expense? Will it lose its toughness and elasticity after being in use for only a short time? Will it stand heat—friction heat plus the heat of a hot summer day without going to pieces? Is it worth while—this saving of 50 cents on a tube at the expense of a good shoe?

Play safe. Get 100% tube value. Buy National "Special" Red Tubes.

National Rubber Company

Factory and Main Office,

Pottstown Pa.

Size	Price	Size	Price
28x3	\$3.10	36x4	\$5.90
30x3	3.20	37x4	6.10
30x3 1/2	4.10	34x4 1/2	7.10
31x3 1/2	4.25	35x4 1/2	7.25
32x3 1/2	4.40	36x4 1/2	7.50
34x3 1/2	4.70	37x4 1/2	7.75
36x3 1/2	5.00	35x5	8.50
31x4	5.20	36x5	8.70
32x4	5.30	37x5	9.00
33x4	5.50	39x5	9.50
34x4	5.65	37x5 1/2	10.30
35x4	5.75	38x5 1/2	10.50

National

Special Red Tube

TRANSCONTINENTAL STUTZ "BEAR CAT"



WORE
THE

Hartford
SHOCK ABSORBER

STUTZ MOTOR CAR COMPANY
INDIANAPOLIS



MAY
EIGHTEENTH
1915

Hartford Suspension Co.,
Jersey City, N. J.

Gentlemen:-

Having just completed my record breaking Coast-to-Coast trip in the Stutz "Bearcat" - setting up a new Trans-Continental auto record of 11 days, 7 hours and 15 minutes, breaking the previous record of six men driving by 4 hours and 55 minutes, I hasten to write you of the wonderful assistance rendered by the Hartford Shock Absorbers on this car.

I have driven innumerable cars, with, and without Hartford Shock Absorbers and have traveled and re-traveled many of the roads over which I had to pass in coming across the country, and while there is no question as to the ability of the Stutz Car, nevertheless, I am convinced that the Hartford Shock Absorber equipment materially assisted in this record.

It is impossible to drive a car and make speed without subjecting it to a great strain, and it would be hard to impose a tougher test on both the car and equipment than driving at high speed through Arizona and New Mexico.

My shock absorber equipment was perfect at the finish, and considering the remarkable performance of this device, and the fact that this record would not have been possible without Hartford Shock Absorbers, I cannot praise them too highly and I honestly think they should be a part of the regular equipment of every car, as they are of the "Stutz."

Very truly yours,

E. G. Baker

A MARVELOUS FEAT

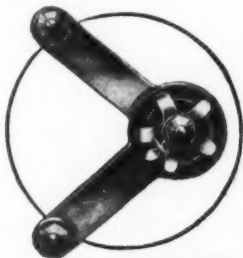
When E. G. Baker smashed the ocean-to-ocean record for automobile travel

he performed a marvelous feat.

The dash from San Diego, California, to New York City, took his sturdy Stutz "Bear Cat" over every kind of road conceivable.

He came through in fine shape in the remarkable time of 11 days, 7 hours, 15 minutes, an average of 25 1/5 miles per hour for 3,728.4 miles, smashing all previous transcontinental records. He says:

"I AM CONVINCED THAT THE



Hartford
SHOCK ABSORBER

EQUIPMENT MATERIALLY ASSISTED IN MAKING THIS RECORD."

His letter, in full, is above.

Here is further striking evidence that the Hartford Shock Absorber

"MAKES ALL ROADS SMOOTH ROADS"

You, too, can travel anywhere at any speed, however rough the roads, with Hartford Shock Absorbers on your car. They stop jolting, jarring and vibration. Contribute to solid comfort. Prevent spring breakage. Make tires last longer. Cut cost of maintenance. Insure longer life for your car.

Write us advising make, model and year of car and we will tell you how to make it truly comfortable.

HARTFORD SUSPENSION CO., 144 Morgan St., JERSEY CITY, N. J.

E. V. HARTFORD, President

Makers of the Hartford Cushion Spring, Hartford Electric Brake, Hartford Auto Jack, Hartford Bumper

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In Your 1916 Models Use

NEW DEPARTURE BALL BEARINGS

American Made for American Trade

Use them wherever an anti-friction bearing is required.

Study these two rear constructions—note the extreme simplicity of the upper layout, with its four New Departure Ball Bearings. Then compare it with the lower plan, with its seven bearings and spherical seated washers. Note the housings required and the expensive machining necessary.

What is true of the rear construction, holds good throughout the entire chassis.

The New Departure Double Row Ball Bearing stands alone among the world's best bearings, in that its ability to accept end thrusts and radial loads in combination, simplifies construction and makes a readjustment of motor car costs possible.

Then, too, you can get New Departure *Guaranteed* Ball Bearings in quantities—when you need them.

Send us your 1916 blueprints. We can show you how to reduce your manufacturing costs through the use of New Departures.

The New Departure Manufacturing Company

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The AUTOMOBILE

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231-241 W. 39th STREET NEW YORK CITY

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Every Customer Demands Comfort

—when he buys a car. A good engine isn't enough. The seats must be restful and resilient, or the sale may be lost.



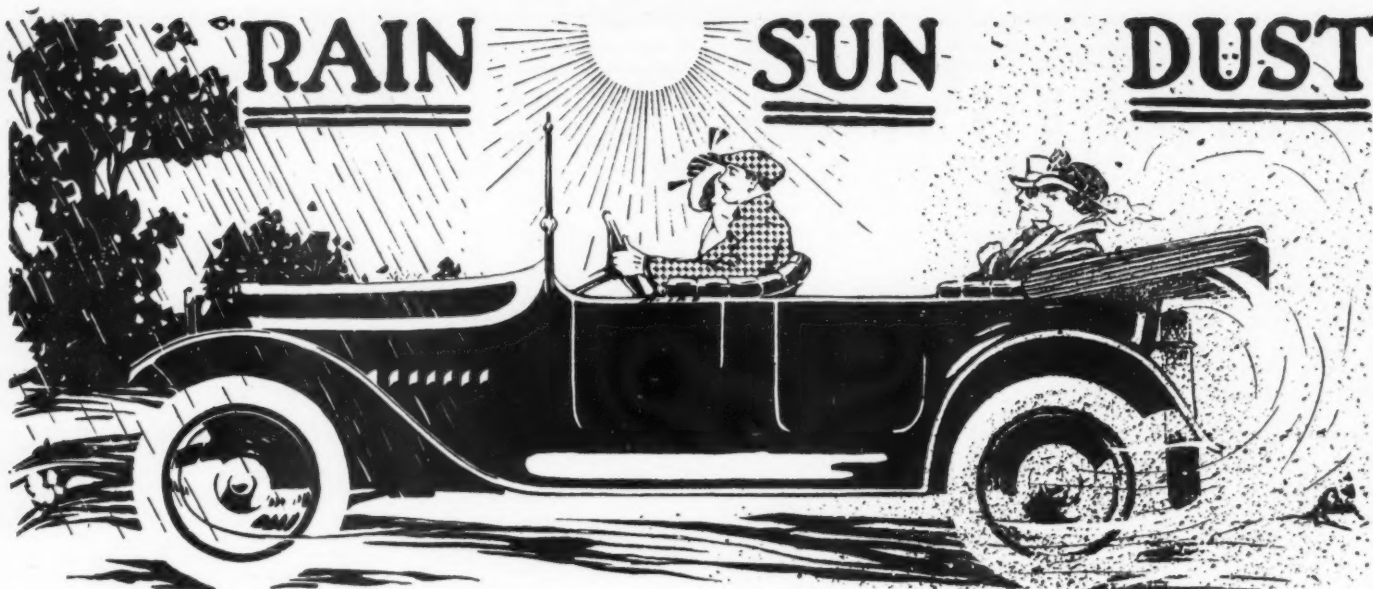
—makes the easiest-riding cushions, that last the longest—at an economical figure.

Its durability and resiliency are unequalled. Holds curl and vitality permanently—"Stands up" under hard usage. In the long run it costs less than cheap substitutes.

Furnished in any grade or color for all purposes. Samples promptly sent on receipt of your specification. Standardize "Sulzberger's" on your cars, for satisfied customers and more sales.

**SULZBERGER &
SONS COMPANY**

CHICAGO  ILLINOIS



Weather Does Not Injure Cars Protected With **JOHNSON'S PREPARED WAX**

"The Weatherproof Body Polish"

Take your car through rain, sun and dust, and bring it out as brilliant and lustrous as when you put the finishing touches on it in the garage. And the reason is that **Johnson's Prepared Wax**

"Sheds Water Like a Duck's Back"

It imparts a hard, dry gloss over the entire body of your car, building up a shining veneer that will not crack or check.

Several coats of **Johnson's Prepared Wax** will revive that appearance of newness, though the varnish on your car may have become rough from wear.

In many cases the timely use of **Johnson's Prepared Wax** saves the expense of having cars revarnished.

Imparts a Hard, Dry Finish, Unaffected by the Hottest Sun

Your car, properly treated with **Johnson's Prepared Wax**, will virtually go through fire and water—and come out unscarred. The hardest rain will not dim its mirror-like polish. The hottest sun has absolutely no effect on its smooth, glossy coat.

Does Not Collect Dust

Johnson's Prepared Wax imparts a perfectly hard, dry, glasslike polish to which the dust cannot adhere. It is quite different from the many oily polishes on the market which gather and hold every speck of dust.

Johnson's Prepared Wax is clean and easy to apply and inexpensive. Increases the value of your car on the market, and gives you the prestige that comes with the appearance of prosperity and class.

S. C. JOHNSON & SON,
Racine, Wisconsin

I enclose 10c for a can of Johnson's Prepared Wax—sufficient for one polish on a large car.

Name.....

Address.....

City & State.....

My Accessory Dealer is.....

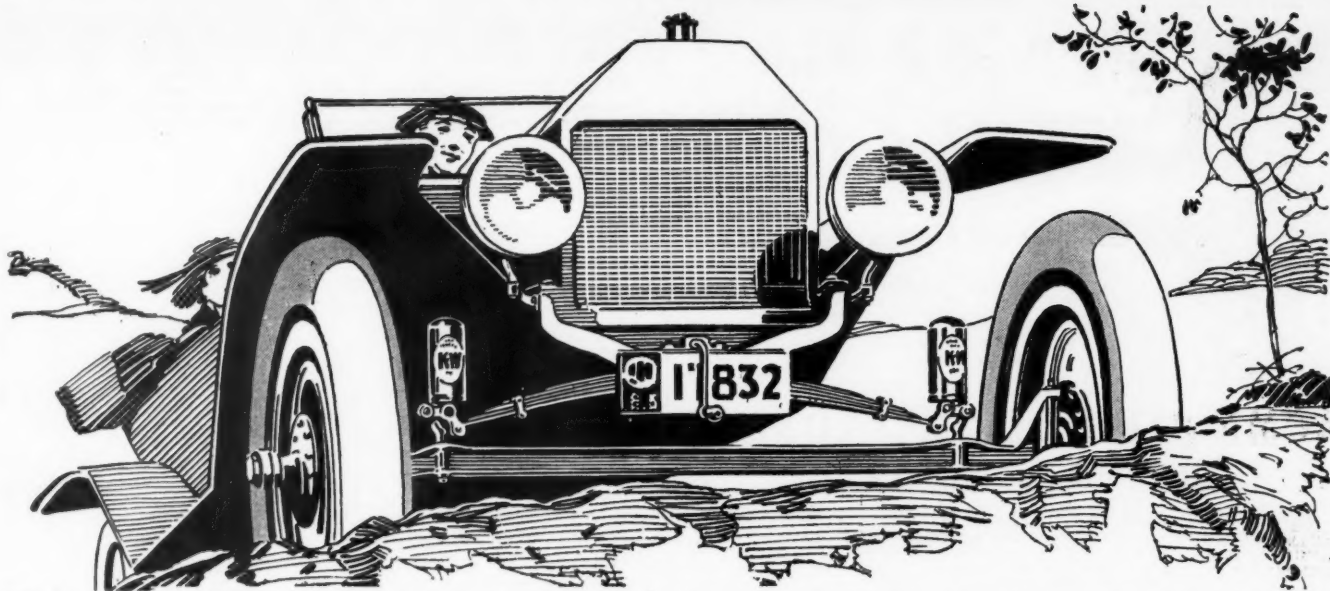
One Pint by Parcel Post 60 cents—
enough for a season's use

Send 10c for Sample Can of
Johnson's Prepared Wax, sufficient for
one application on a large car.
Agents Wanted.

S. C. Johnson & Son
"The Wood Finishing Authorities"
Racine, Wisconsin



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There are Two Kinds of Comfort—Body and Mind—You Get Both With



Road Smoothers

QUICKLY APPLIED TO YOUR FORD CAR

They give you the body comfort that comes only from motoring "relaxed" in a smooth riding car—regardless of the road's roughness. They give you mind comfort—that freedom from the tiring effort of steering around bumps and ruts so common to the average road. You are relieved of the nerve-racking tension of "picking the road." You get the same comfort as your passengers, plus the pleasure of "no road worry" driving.

K-W Road Smoothers give you this enviable comfort because their design combines these three vital factors:

1. A spring to effectively take up the shock.
2. An anti-rebound air chamber to check the rebound.
3. Anti-side motion links to prevent side rocking and swaying.

Each of these features is in itself vital to your comfort and safety. It's only when they are combined in one device that you will get the greatest pleasure from your car. Here's how the K-W Road Smoother fills all these requirements:

The K-W Springs

A helical spring that effectively takes up the shock, made of electric smelted, chrome vanadium steel. The K-W bracket design allows almost twice the length of spring action or "travel" (in actual service) of any other.

The K-W Air Chamber

The anti-rebound air chamber with its smooth fitting piston acts like a door check, and gently "eases off" the rebound of the spring. This is an exclusive K-W feature. Its design provides a strong, tough, self-lubricating piston, working in a dust-proof air chamber. It requires no attention.

The K-W Side Motion Links

Made of the highest grade heat-treated drop forgings of remarkable toughness. This enables them to withstand the great strain put upon them. They prevent your car from pitching, swaying or skidding while making sharp turns.

\$15 SET OF FOUR
ONE FOR EACH WHEEL



K-W Bushings

All bearings are phosphor bronze throughout. That means long life.

But you can find all of these vital factors only in K-W Road Smoothers

That is why they lengthen the life of your car, by eliminating shock and vibration. Tire economy is assured, because K-W Road Smoothers enable the wheels (not the whole body of the car) to follow the contour of the road. That means no grinding off the rubber of the tires. K-W Road Smoothers always make good because they are built with characteristic K-W Quality throughout.

But after all's been said and done, it's results that count; and the K-W guarantee covers not only workmanship and material, but results as well.

K-W Road Smoothers are quickly and easily attached. No holes to drill and no tools necessary except a wrench. And the final and biggest advantage you get from K-W Road Smoothers is that they increase the radius of your car's usefulness, and bring you home with that "satisfied feeling" after a day of comfortable motoring.

If your dealer can't supply you, sent prepaid upon receipt of price.

Write for booklet "That Satisfied Feeling"

THE **K-W** IGNITION CO.
2835 CHESTER AVE. CLEVELAND, OHIO, U.S.A.
Makers of 125,000 K-W Master Vibrators

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Big Profits Made Grinding Cylinders!

Garagemen—Repairmen: Make scored cylinders of the cars you overhaul good as new. True up the cylinders if they are worn and thus increase motor power. Make good profits and satisfied customers. Hundreds of others doing big business.

ACME CYLINDER GRINDER

Quickly Pays for Itself

Can be attached to any lathe. ACME has same advantages as large cylinder grinding machines costing \$1300 to \$2000. The price of the ACME is within reach of every progressive garage and repairman. Guaranteed for 1 year.

ACME does not require the cylinder to be rotated. Grinds 4's 8's, 12's just as easily as single cylinders.

Are You Getting the Profitable Cylinder Grinding Business in Your Town?

Constructed of best materials. Anyone can operate it. Easily adjusted.

FREE BOOKLET Write for it. Contains full details. You want to make more money. Here's the way.

The Acme Grinder Company
Minneapolis, Minnesota

The WYMAN & GORDON CO.

DROP FORGED CRANK SHAFTS

Are used by the
LEADING ENGINE BUILDERS

Long years of experience in the making of crank shafts has developed our products to the point where they are recognized as unequalled, today our forgings are acknowledged as the standard for

**RELIABILITY
STRENGTH - TOUGHNESS**

They have honestly earned the reputation

WORCESTER, MASS., CLEVELAND OHIO



Send Blue Prints for Estimates

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NOXAL

SHOCK ABSORBER

\$8.00
FOR
FORDS
Set of 4

The only Ford shock absorber which is GUARANTEED not to change or alter Ford design or construction, or to increase mechanical strains or stresses in any degree whatever.

Guaranteed for Life of Car

This guarantee is only made possible by the fact that NOXALS, having but ONE point of frictional contact, are practically indestructible.

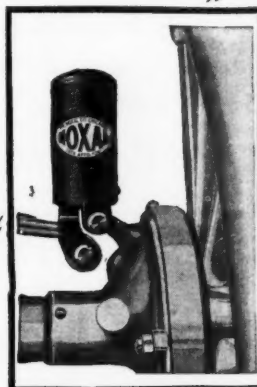
NOXALS decrease the vibrations to which your Ford car is subjected over 300%. Attached by anyone without filing, fitting or machine work. No castings, no unmachined bearings, no stampings used.

Sold on 10 Days' Trial

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Satisfaction Guaranteed or money returned.
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We maintain a complete stock of
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We will paint these bodies any color and up-
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Only \$100.00.
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Only \$125.00.
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All Four Cylinder Four Cycle.

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Can't Rust Your Rims, or Make Your Tires Stick

When one coat of Peerless Anti-Rust Rim Paint
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The Clearing House — continued

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World's Lowest Prices—Largest Stock
Yale Lock Ignition Switch
This is the \$3.50 kind—our price, each \$1.98

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A special lot of Jones and Stewart speedometers from \$6.00 up.

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Springs last longer—ride easier, special .50

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No shammy gasoline strainers..... .50
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Trunk racks, standard sizes, solid steel, fold back when not used—worth \$5.00; our price, each..... 2.25

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Perfect black and nickel electric side lamps, pair 2.50
Largest stock of electric and gas headlights, electric and oil side and tail lamps at big bargains.

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20 only \$12 for 5. Gas and Electric Head Lamps for Fords and similar sizes only \$3.25 pair. Stylab Side Electric Bullet Lamps, \$3 pair. Electric Tail Lamps, \$1. One-third deposit with C. O. D. orders.

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Prices same as old Henderson List. Price list upon application.

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Compare them with those of other dealers and you will realize how much you can save by buying from us, including

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The Clearing House — continued

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apply one coat of Peerless Lining Dye to make the lining of your dirty, stained and grease-spotted top a dark, uniform color. Ask anyone selling automobile supplies.

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The Clearing House - continued

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You want the heavy bodied, rich gloss Peerless Jet Black Fender Japan to give the tone and imitation of a baked enamel finish for your fenders. Ask anyone selling automobile supplies.

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Our special facilities enable us to do highest grade work Over 225 Piston Patterns

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repaired by electricity. Filled with silver composition. Same piston and rings used. No warping of cylinders. Also Welding.
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Fitted with my heat treated light weight pistons and patented three section rings. From \$6 to \$15 per cylinder.

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30x3 1/2	5.75	6.25	35x4	8.50	9.50
32x3 1/2	6.50	7.00	36x4	8.75	9.50
32x4	8.00	8.50	34x4 1/2	9.50	10.50
33x4	8.00	8.75	35x4 1/2	9.50	10.50
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Non-Skids all sizes 10% Extra

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These Tires Average About 5000 Miles

Size	Tires	Tubes	Size	Tires	Tubes
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30x3 1/2	7.50	2.42	34x4	9.75	3.35
32x3 1/2	8.00	2.55	36x4	10.00	3.58
34x3 1/2	8.50	3.00	34x4 1/2	11.50	4.24
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30 x 3 1/2	6.50	7.50	2.15
31 x 3 1/2	7.25	2.20
32 x 3 1/2	7.50	8.50	2.25
34 x 3 1/2	8.00	2.35
30 x 4	8.50	2.85
31 x 4	8.75	10.25	2.95
32 x 4	8.50	10.00	3.05
33 x 4	9.00	10.50	3.10
34 x 4	9.00	10.50	3.20
35 x 4	10.00	11.50	3.30
36 x 4	10.00	11.50	3.35
34 x 4 1/2	12.00	13.50	4.00
35 x 4 1/2	12.50	14.00	4.10
36 x 4 1/2	13.50	15.00	4.15
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30x3 1/2	6.00	6.50	34x4 1/2	10.00	11.00
32x3 1/2	6.50	7.00	35x4 1/2	10.00	11.00
34x3 1/2	7.50	8.00	36x4 1/2	10.00	11.00
30x4	7.00	7.50	37x4 1/2	11.00	12.00
32x4	8.00	8.50	34x5	10.00	11.00
33x4	8.00	9.00	35x5	12.00	13.00
34x4	8.00	9.00	36x5	12.00	13.00
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30 x 3	4.00 5.00	36 x 4	8.00 9.00
30 x 3½	5.00 6.00	34 x 4½	9.00 10.00
32 x 3½	6.00 7.00	35 x 4½	9.00 10.00
34 x 3½	7.00 8.00	36 x 4½	9.00 10.00
30 x 4	6.00 7.00	37 x 4½	10.00 11.00
32 x 4	7.00 8.00	35 x 5	11.00 12.00
33 x 4	7.00 8.00	36 x 5	11.00 12.00
34 x 4	8.00 9.00	37 x 5	11.00 12.00

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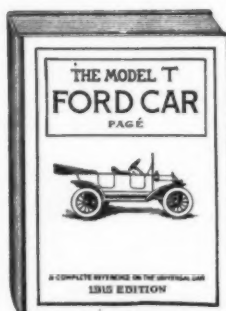
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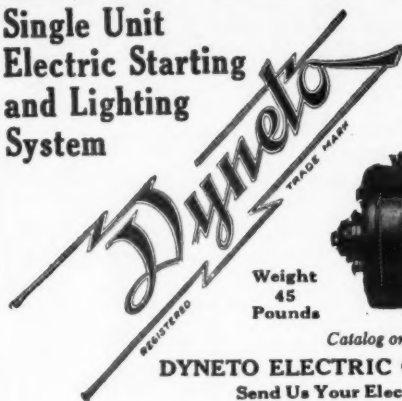
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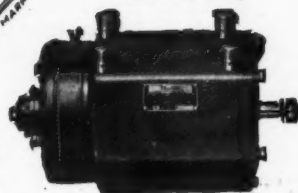
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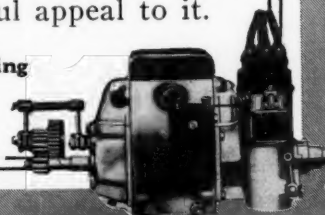
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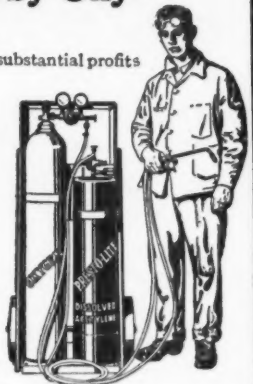
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Uniformity
Prestige
Experience
Stamina

Continental Motors

CONTINENTAL MOTOR MFG. CO.
DETROIT, MICH.

TRADE MARK

Raybestos

REG. U.S. PAT. OFF.

THE PRODUCT OF BRAKE SPECIALISTS

USED FOR
BRAKE LINING - CLUTCH FACING

Manufactured by
THE ROYAL EQUIPMENT COMPANY
Bridgeport Conn.

Please mention The Automobile when writing to Advertisers

The Parish & Bingham Co.

Cleveland, Ohio

The Standard Of Quality & Service

Automobile Frames
And Large Steel Stampings

Our Engineering Force At Your Disposal

De Palma, Winner of the Indianapolis 500 Mile Race

Has never experienced lubricating trouble.
De Palma has always used MONOGRAM
OIL, which is proof that it is

"Best For Your Engine"

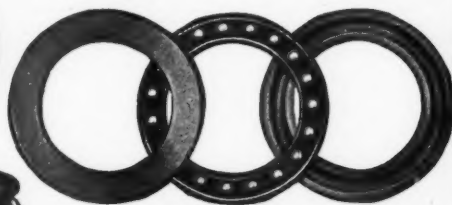
NEW YORK LUBRICATING OIL CO.

Consolidated with Columbia Lubricants Co. of N. Y.
116 Broad Street, New York City

Branches at Newark, Boston, Chicago, Cleveland, Philadelphia,
Portland, Me.; Seattle, Portland, Ore.; San Francisco, Los Angeles,
Spokane, London, England; Johannesburg, South Africa.

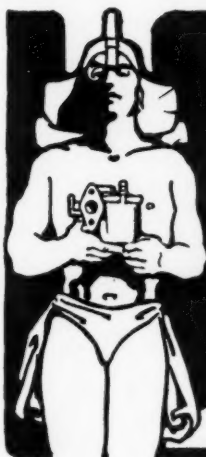
The Bearings Company of America

Sales Department 250 W. 54th St., New York



COMPLETE THRUST BEARING

Manufacturers of Star Radial Ball Retain-
ers, Star Ball Thrust Retainers, Star
Complete Ball Thrust Bearings



ZENITH CARBURETOR

KKNOWN the world over as
the zenith of simplicity
and efficiency.

A precision instrument giving
permanently, exact carburetion
for your car.

Zenith Carburetor Co.
Detroit, Mich.



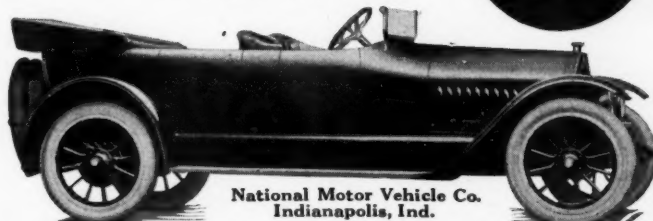
The Improvement in RADIATORS

NATIONAL CAN COMPANY, Detroit, Mich.

Highway Six

National
Newport Six \$2375

\$1690

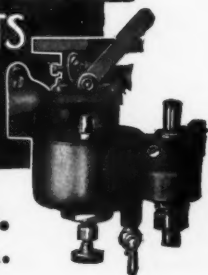


National Motor Vehicle Co.
Indianapolis, Ind.

HOLLEY CARBURETOR

NO MOVING PARTS
ONLY ONE ADJUSTMENT

WRITE FOR
PARTICULARS



Holley Brothers Co.
Detroit Mich.

REPUBLIC TIRES

PLAIN, "WM"
AND STAGGARD TREADS

TRADE MARK REGISTERED
U. S. PATENT OFFICE

Please mention The Automobile when writing to Advertisers



Corcoran Lamps
GAS, OIL, AND ELECTRIC
CORCORAN LAMP CO.
CINCINNATI, O.

ADAMSON VULCANIZERS

Half a million in use tells a story of universal satisfaction
—several times more than all other makes combined, and not a single vulcanizer has failed to give pleasing results.
The ADAMSON is the "Modern" vulcanizer—the only exclusive and complete line—from the small portable vulcanizers for motorists' use on the road or at home, to the complete equipment for Garages and Repair Shops.
Adamson Mfg. Co., East Palestine, Ohio

RIMS

Of every description and character. Manufactured in the only absolute fire-proof Rim factory in America. This protection should appeal to you.

JACKSON RIM COMPANY
Jackson Michigan



BRAENDER Tires & Tubes

are Famous for their
QUALITY
We wish to announce that irrespective of action of any other organization **BRAENDER QUALITY WILL BE MAINTAINED.**
Braender Net Prices to Car Owners

Tires	Plain	Non-Skid	Gray Tube	Red Tube
30 x 3	9.00	10.35	2.35	2.60
30 x 3 1/2	11.60	13.35	2.70	3.00
36 x 4 1/2	27.35	31.45	5.20	5.80
37 x 5	32.30	37.15	6.30	7.00

Braender Rubber & Tire Co.
Main Office & Factory: RUTHERFORD, N. J.
New York, 250 West 54th St.
Agents in principal cities

Established Agents Solicited



EISEMANN

The most simple—the most accessible—the most durable—the most efficient magneto ever produced is the new Type G-4.

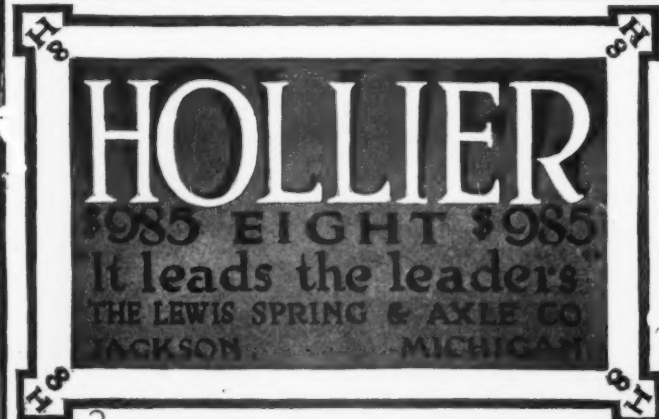
The Eisemann Magneto Company
Sales and General Offices,
32-33d St., Brooklyn, N. Y.
New York, N. Y. Indianapolis, Ind. Detroit, Mich.
245 W. 55th St. 415-417 N. Capitol Av. 802 Woodward Av.

Gas Engine Troubles and Installation

By J. B. RATHBUN, B.S.C.E.
Author of "Commercial Vehicles for All Purposes," "Oxygen-Acetylene Welding," etc.

440 Pages, 150 Detailed Line Drawings and Illustrations.
A book that shows you HOW TO INSTALL—HOW TO OPERATE—HOW TO MAKE IMMEDIATE REPAIRS and HOW TO KEEP A GASOLINE ENGINE RUNNING. The language is simple. The illustrations are clear. The book is authentic—complete—up-to-the-minute, written by an expert who is employed daily as a Consulting and Demonstrating Engineer and Instructor. Nothing has been omitted—it contains no useless matter—Just the cream of daily experience. Two Folding Trouble Charts.

Sent for \$1.50 Prepaid
Book Department **THE AUTOMOBILE** 231-241 West 39th Street
NEW YORK CITY, N. Y.

HOLLIER

\$985 EIGHT \$985
It leads the leaders
THE LEWIS SPRING & AXLE CO.
JACKSON MICHIGAN

SHALER VULCANIZERS

Electric—Steam—Gasoline—Alcohol
There is a Shaler Vulcanizer for every purpose from The Tourists' Models to carry in the tool box to large equipment for Garages—Tube-Kit \$2, Ford Kit \$2.75, Vul-Kit \$3.50, Model D \$12.50 and Vulcanizing plant for Repair Shops \$60.
The Shaler is recognized as standard and is used in best Garages and Repair Shops everywhere. We are the world's largest Vulcanizer makers and Guarantee every Shaler Model.
Write for complete new catalog.
C. A. SHALER CO., 125 Fourth Ave.
Wausau, Wis.



BOSCH
MAGNETOS

were used by all cars in all the big races of the year, because Bosch is the most reliable ignition.

Be Satisfied—Specify Bosch

Bosch Magneto Co.
220 W. 46th St., New York


WARD LEONARD
25 years experience

DYNAMO CONTROLLERS

For Lighting and Starting Systems

WARD LEONARD ELECTRIC CO.
Bronxville, N. Y., U. S. A.

What About Lights And Starting Motor?
How do you know when they will fail you?
Don't Take Chances!



Weston
Model 354 AMMETER
On Your Dashboard or Cowl

will keep you posted every minute regarding electrical conditions. It gives you warning of approaching trouble. Its exact information is invaluable—the cheapest and best insurance you can buy.

Write for full information.
Weston Electrical Instrument Co., 8 Weston Ave., Newark, N. J.
Branches in the larger cities

Lexington
CRITERION OF ITS CLASS

Thoroughbred Six—\$1875
Minute Man Four—\$1375
Six Supreme—\$2575

Equipped with Moore Multiple Exhaust System

Write for details and co-operative dealer proposition.

The Lexington-Howard Co., Columbia Ave., North
Connersville, Ind., U. S. A.

WE NOW OFFER

THE SEARCHLIGHT WELDER

A complete outfit for Oxy-Acetylene Welding

AT \$50.00

HIGH IN QUALITY LOW IN PRICE

Write for complete information to

THE SEARCHLIGHT COMPANY
1016 Karpen Bldg. Chicago, Ill.

Avoid Costly Blowouts



Use These Quick Tire Plasters

Don't be penny wise and pound foolish. A few cents spent on a Goodyear Tire Plaster will save you many a dollar in ruined casings and tubes.

They are small—that's true—but they prevent a multitude of big tire troubles.

Ask your dealer for them today. It takes but an instant to apply. If you discover a weak spot in your casing apply this patch at once and then ride care free for hundreds of extra miles.

These patches are for fabric-breaks or blowout purposes. They are flat and one side is coated with an adhesive friction, which insures tight application. Patch has fabric edge to fit under the bead.

Goodyear makes 22 Tire Savers. Each will save you countless tire delays. Write today for complete list. Address Desk 36

THE GOODYEAR TIRE & RUBBER CO., AKRON, OHIO
Makers of Goodyear Automobile Tires (2437)

SALISBURY

AXLES WHEELS PROPELLERS

Salisbury Wheel & Mfg. Co.
JAMESTOWN, N.Y.

Swedish Steel Double Row Ball Bearings

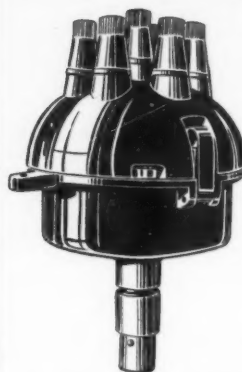
SKF

S.K.F. Ball Bearing Co.
50 Church St. New York

NEW PROCESS DIFFERENTIALS and ACCURATELY CUT METAL GEARS



**NEW PROCESS
GEAR CORPORATION**
SYRACUSE, N. Y.



The Atwater Kent Ignition System

Used by one-quarter of all
1915 U. S. A. built cars, ex-
clusive of Fords.

4938 STENTON AVENUE
Philadelphia, Pa.



Brown Jr. Tire Pump

New Price with "T" Gauge, \$5.50

Built like a motor with
ground rings. A high grade
pump at a small price. For
medium - size Tires. You
cannot afford to run your car
without this pump.

Send for leaflet—just off the
press.

THE BROWN CO.
210 Bellevue Ave., Syracuse, N. Y.

THE AUTOMOBILE ENGINEER

PUBLISHED MONTHLY

The only technical journal in the world solely devoted to the
theory and practice of Automobile Construction.

Among the subjects dealt with are: Chassis Design; Engine
Design; Parts and Accessories manufacture; Metals; Machine
tools; Fuels; Shop practice; Works organization and equipment.
Each issue contains invaluable information for manufacturers,
designers and departmental managers.

U. S. A., \$2.20

Subscription Rates:

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The Publishers:

ILIFFE & SONS, Ltd., 20 Tudor Street, London, E. C.

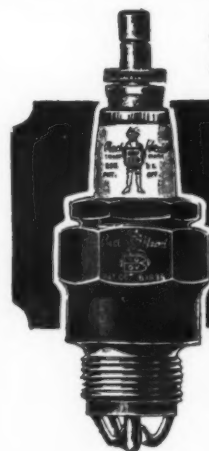
Electric Auto-Lite Starting—Lighting—Ignition

Electric Auto-Lite equipment for auto-
mobiles is as famous for the service that
backs it as for the reliability and economy
of its operation.

ELECTRIC AUTO-LITE COMPANY

Home Office and Factory: Toledo, Ohio

New York Detroit Kansas City San Francisco



Link your motor to the **BIG
BOY**—the big plug for big deeds

Red Head
REG. U. S. PAT. OFF.
GUARANTEED FOREVER

Big Boy \$1.00
Regular75
Priming 1.25
Combination 1.25
Platinum Point 1.50

EMIL GROSSMAN MFG CO., INC.
Bush Terminal Model Factory No. 20
Brooklyn (New York City).

KB QUALITY UNIVERSAL JOINTS

WE ARE SPECIALISTS IN THE MANUFACTURE OF
UNIVERSAL JOINTS

Made from finest drop forgings, case hardened throughout. Inter-
changeable with other Universals. We guarantee prompt deliveries
AMERICAN DISTRIBUTING CO., Detroit, Mich.
Factory Sales Representatives.

Kinsler-Bennett Co. Hartford, Conn.



Hyatt Quiet Bearings

HYATT SERVICE STATIONS

Atlanta, Ga. Detroit, Mich.
Boston, Mass. Los Angeles, Cal.
Chicago, Ill. New York,
Minneapolis, Minn.

(Harrison, N. J.)

SERVICE AGENTS

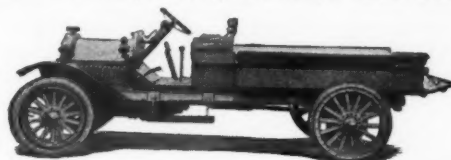
Hyatt Quiet Bear-
ings are used in
the majority of
American made
Automobiles

High Wycombe, England
Broom & Wade

HYATT ROLLER BEARING CO.
DETROIT, CHICAGO
NEWARK, N. J.

Extravagance of Old Fashioned Equipment

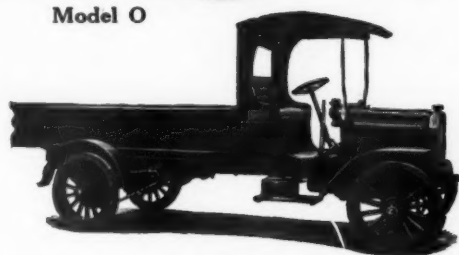
That the best and most successful organizations in the Commercial World are adopting Motor Trucks proves their economy. Why not follow their lead?



Model O

Model O
¾ Ton
\$1350
Express
\$1290
Chassis

Model M
4000 lbs.
Capacity
\$2000
Express
\$1910
Chassis



Model M

Built along good sound engineering principles, of good material, by good workmen, and most important of all, by a Conservative Organization of men who KNOW HOW.

Some territory is still open to Dealers. Send for our Sales Plan and copy of Contract for your territory.

Sanford Motor Truck Company
SYRACUSE, N. Y.

PATENTED

The New Appliance For Headlights



KLEARGLOW is the latest and most improved device for its purpose. Originated in Switzerland—popular throughout Europe. Made entirely of scientifically designed, corrugated glass surfaces. Takes away the glare that causes so many motor car accidents—so many smashed cars—yet does not absorb any of the power furnished by the lamps, as with dimmers and similar devices. KLEARGLOW casts *all* the light *all* the time. "Dimmers" are dangerous—KLEARGLOW is safe. KLEARGLOW does not have to be removed when making country trips, in order to obtain enough light.

KLEARGLOW
The Auto Light Diffuser

gives all the *safe light without the dangerous glare*. Lamps equipped with KLEARGLOW conform to the varying laws of different localities covering automobile headlights. KLEARGLOW prevents the arrest and fine of owner or chauffeur, saving much expense, loss of time and unnecessary annoyance. You ought to put KLEARGLOW on your car *now*. Fits any car and goes in place of present headlight glass. Will make your car look better. The moderate price—\$3.75 per set—is really an investment—for it is proof against injury to person and damage to car as well as police interference due to common headlights.

Our interesting illustrated folder points the way to better and safer motor trips. Tells about our fifteen-day trial offer—we make KLEARGLOW "prove up" before you buy. Just drop a post card for the folder TODAY. Address

**To JOBBERS and
DEALERS:**

KLEARGLOW is a *real* sales promoter. It is a motor car necessity that sells easily. Ask us about our unusual proposition for you.

H. G. PARO
759 Michigan
Boulevard Bldg.
Chicago, Ill.



Simplicity!

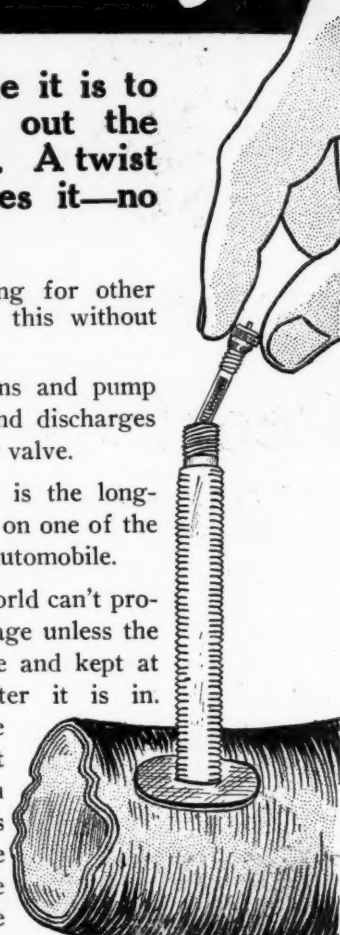
See how simple it is to put in or take out the Henemier Valve. A twist of the wrist does it—no tools required.

If you've gone fishing for other valves you'll appreciate this without our saying more.

Fits all standard stems and pump connections. Accepts and discharges air faster than any other valve.

The Henemier Valve is the long-looked-for improvement on one of the most vital parts of the automobile.

The best tire in the world can't produce its maximum mileage unless the "air" is kept in the tire and kept at the right pressure after it is in. And the every-day tire valve, which hasn't changed a bit in form or principle since it was first made for bicycle tires, doesn't keep all the air in the tire all the time.



The HENEMIER VALVE-INSIDE

MADE UNDER U.S. LETTERS PATENT



keeps the air in all the time—keeps the pressure up all the time—keeps it properly inflated all the time.

Write for sample—test it yourself
—then you will have a pretty good idea of what we are telling you to tell your customers to buy.

The illustration will give you a very fair idea of the Henemier Valve, and when you send for the sample you will be able to appreciate the advantages of the Henemier Valve over all others in just about one-half of a minute.

Packed 100 in a box to retail at 5c each. Write for samples and trade discounts today to

The Riess Mfg. Co.

Sole Licensees and Manufacturers

1690 Broadway at 53rd St. New York, N. Y.

Please mention The Automobile when writing to Advertisers

The Daily SAE

Published Aboard the
Noronic and Printed
Morning and Evening
West

JUNE 16, 1915

**SPLendid
IN METROP
MINSTRE**

Easterners Delic
ical Audience
Clever Pr

POKE FUN

**E. CRUISERS
T MIDLAND
LIANT RED**

ession of Town
Circus In
Street

RIOT RACE

Members of the S. A. E. equipped with Peerless Goggles

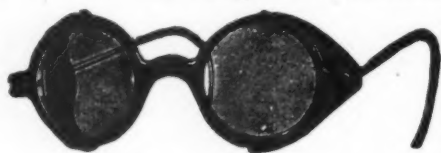
The Eye Savers That Received the
Greatest Endorsement Ever Ac-
corded an Automobile Accessory

Practically every member of The Society of
Automobile Engineers wore PEERLESS
GOGGLES on their recent convention trip.

PEERLESS EYE PROTECTORS are good
to look at, and good to see through. They pro-



TECT the eyes per-
fectly, they are
equipped with
dust shields if de-
sired, and have
the wonderful,
new PATENT-
ED ADJUSTABLE TEMPLES. These ear
bars may be adjusted to any length or position
desired. They
cannot be
broken by
bending.



The most
comfortable and most satisfactory Goggle ever
built, regardless of price, yet with or without
dust protectors and at popular prices.

Dealers everywhere sell the famous PEER-
LESS GOGGLES—the greatest success since
Goggles have been invented.

Dealers. If you are still selling the old-
fashioned Goggles, write for our
proposition.

Max G. Cohn & Company, Inc.
19 Madison Avenue at 25th Street
New York, N. Y.

MASTER CARBURETERS

Reg. U. S. Patent

A Master production for trouble reduction.

ANNOUNCEMENT

Greater facilities for increased production have
been made by the purchase of a new factory
located at 1523-31 Fort St. West. General
offices will now be located at above address.

MASTER CARBURETER CORPORATION

1523-31 Fort St. W., Detroit, Mich.

Pacific Coast States: Master Carbureter Co., Inc., Los Angeles, Cal

**HANG ON TO YOUR OLD TIRES
THEY CAN BE USED FOREVER
WHEN COVERED WITH
STEEL**



The Kimball Steel Protector makes Blow
Outs, Punctures and Rim Cuts impossible. A
few sections will hold any old blowout. Tires are
as flexible as ever. Send for detailed information.
KIMBALL TIRE CASE CO., 171 Broadway, Council Bluffs, Iowa.



SPARTON

Hand Horns

NEW PRICE

\$4.00

DELIVERIES NOW

ALL DEALERS

THE SPARKS-WITHINGTON CO., Jackson, Mich.

OMC

**DOUBLE ACTION
SHOCK ABSORBERS**

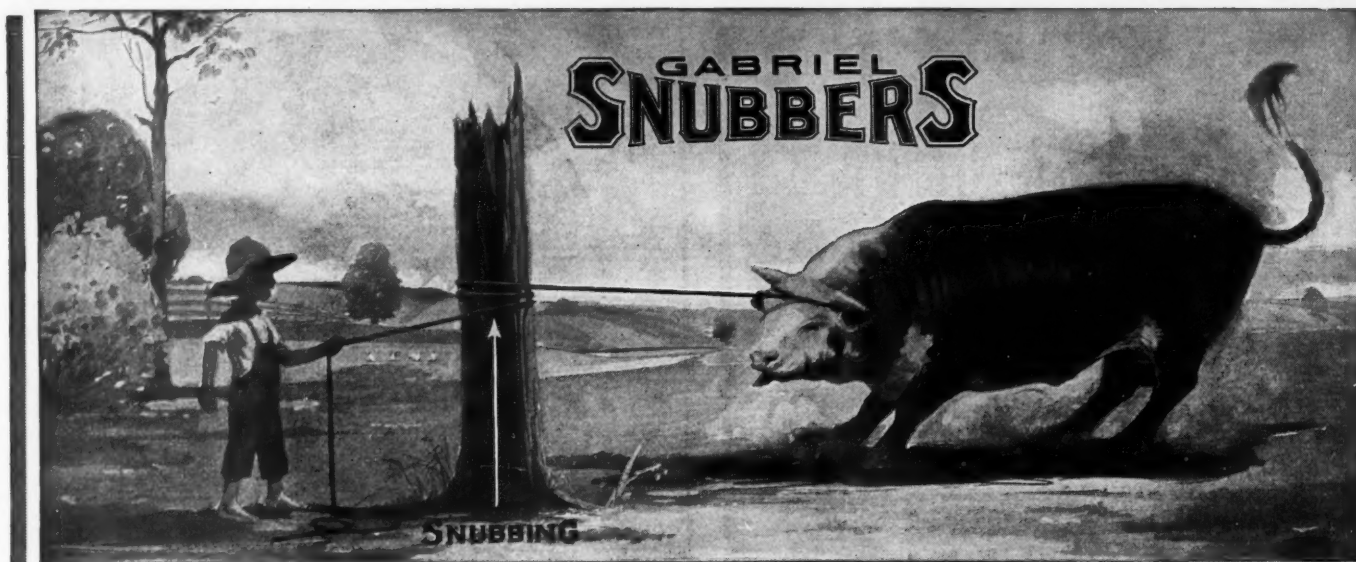
HEAVY CAR TYPE

\$35.00 to \$45.00 per SET

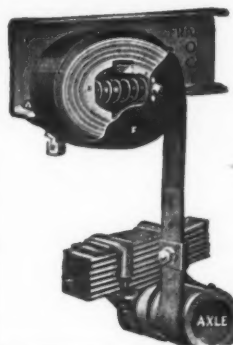
FORD TYPE \$15.00 per SET

A. J. PICARD & CO.

1720-22 BROADWAY NEW YORK



IT'S THE COIL THAT HOLDS THE BULL



- ¶ Every pull only tightens the rope and makes the friction greater.
- ¶ Every jolt from crosswalk, rut or other unevenness tightens the coil of belting inside the Snubber and retards rebound of springs.
- ¶ A smooth band of brass between layers of belting, graduates the friction and snubs the rebound gradually and firmly.

—and That's Why

Snubbers make your car ride practically as easy on rough roads as on smooth ones—whether your car has one occupant or six or eight.

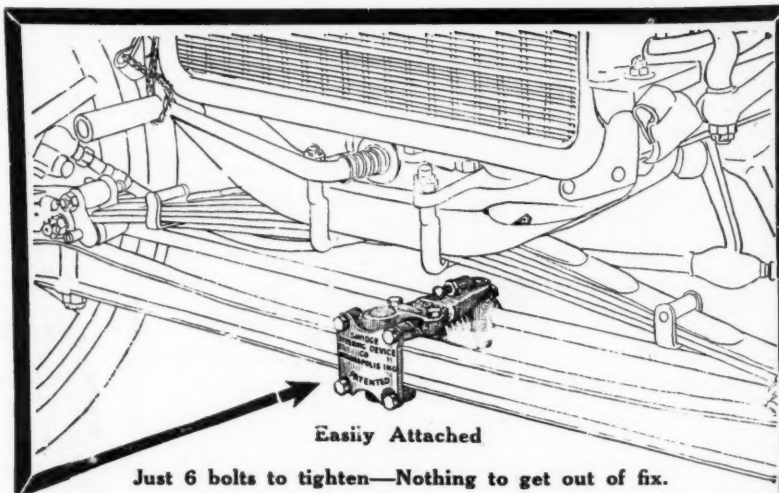
Let us send you booklet.

GABRIEL MFG. COMPANY, 1424 East 40th Street, Cleveland, Ohio

SAVIDGE

Steering Device for FORD Cars

Simple—Sturdy—Safe—Silent.
Built along proven engineering lines especially for Ford Cars and backed by men who know the Ford accessory business.



The Savidge will Absolutely do this for Your Ford

Takes the wobble out of the front wheels.
Acts as a shock absorber on the steering gear.
Eliminates rattle and vibration.
Enables you to turn corners safely at greater speed.

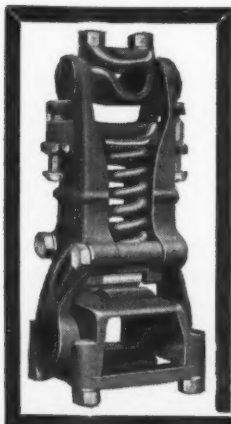
Saves tire expense.
Give you perfect, positive control of your car.
Make your Ford as safe and enjoyable to drive as the \$5,000 car equipped with a worm steering gear.

Sold on a Satisfaction Guaranteed Basis. ORDER NOW!

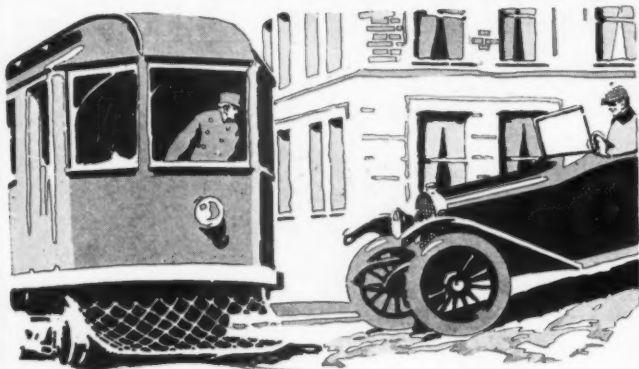
The Savidge Steering Device Co. own and control all the basic patents for this device. Remember the name SAVIDGE. Avoid imitations. Dealers—Write for our liberal dealers' proposition. There is a good profit for you.

Savidge Steering Device Co.
512 Murphy Building Indianapolis, Ind.

\$4.90



Please mention The Automobile when writing to Advertisers



**20 to 60 Horse Power makes
your Car go.**

What Stops It?

Do you realize that three-fifths of all automobile accidents come from faulty brakes?

Do you realize that faulty brakes come from inefficient brake lining?

Have you inspected your own brake lining within a month?

Thermoid HYDRAULIC COMPRESSED Brake Lining-100%

is absolutely dependable always. It isn't made of fabric that grips on the surfaces alone. It is one single solid substance all the way through—compressed hydraulically. It gives 100% friction even though worn paper thin. You can put your implicit trust in Thermoid.

Watch your brake lining. For surety and safety get Thermoid. You will find it at any conscientious dealer's. Ask him.

Thermoid Rubber Co.
Trenton, N. J.

Makers of Nassau Tires

Our Guarantee—Thermoid
will make good or WE will



Cannot be burned out or affected
by oil, heat, water, gaso-
line or dirt



FAFNIR BALL BEARINGS

THEIR EXTREME SILENCE WILL AP-
PEAL.

THEIR INTERCHANGEABILITY AND
UNIFORMITY COMMEND THEM.

IF YOU ARE OPEN TO CONVICTION A
FEW SAMPLES WILL CONVINCE—CON-
TINUED USE WILL CONFIRM.

"AMERICA'S QUALITY BEARING"

FAFNIR BEARING CO.
NEW BRITAIN, CONN.

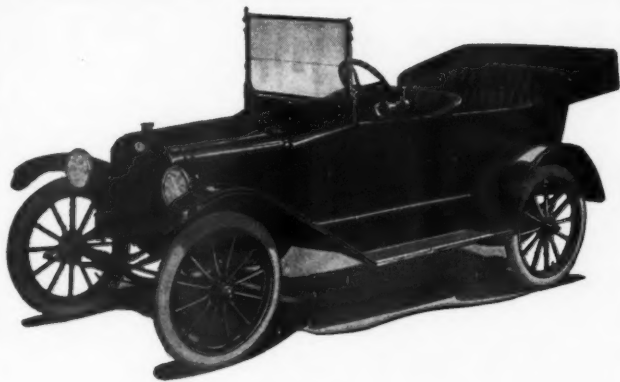


The Midgley Patented Wire Tread Tire

Midgley Tires give you exactly what your trade demands—the extreme high limit of quality at a low cost per mile of service. They are sold under a 6000-mile adjustment, and remain non-skid to the very last mile. They are practically proof against puncture and blow-out. These are facts, thoroughly demonstrated and vouched for. Write for terms and for Booklet No. 13.

Midgley Non-Skid, Plain Tread and
Inner Tubes, Manufactured Only by

— The —
Midgley Tire & Rubber Co.
Lancaster, Ohio



METZ '25

The Quality Car

A GREAT BIG PROPOSITION FOR DEALERS

This new Metz Touring Model will help you to do a much bigger business, and a very profitable business. The demand for just such a car as this will show a greater increase this year than ever before.

Listed at \$600 its equipment includes Gray & Davis electric starter and electric lights, rain-vision windshield, one-man top, luxurious upholstery, 32-inch wheels, 3½-inch Goodrich clincher tires, Bosch magneto, Hyatt bearings, gasoline gauge, speedometer, signal horn, tools, etc. It is a handsome appearing car, a car any owner will be proud of, and so simple in operation that a woman can safely drive it. It will pay you to handle the METZ.

Write for particulars and New Catalog "J"

METZ COMPANY, WALTHAM, MASS.



For Trimming The Best Cars Built

Distinctive Color Effects and of a texture that is absolutely different.

Sun-proof, Water-proof and almost Wear-proof.

We are headquarters for Rubberised Auto Leathers for Tops, Curtains, Cushions.

**Write today for
Samples and Prices**



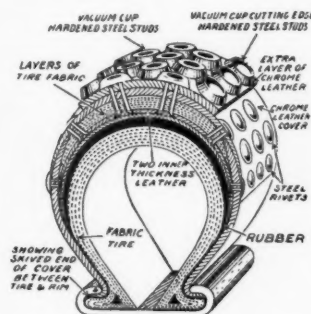
10,000 MILES GUARANTEE BACKS THIS TIRE

Bricton Pneumatic Tires



Try Them at Our Expense

TRY Bricton Pneumatic Tires at our expense. Don't pay until you are satisfied. At our risk find out for yourself what wonderful service Bricton Tires give—how resilient and easy riding they are. Get rid of punctures, blowouts and rim cuts. Bricton Tires are rut proof, oil proof and gasoline proof. They are sold under a specific 10,000-mile written service guarantee.



Your Tires Rebuilt the Bricton Way

If the fabric in the tires you are now using is in good condition, we can take them, make them proof against rim-cutting, punctures, blowouts, side wall breaks, skidding, ruts, oil, and give thousands of miles additional service.

Sign and send back coupon for full information and details of our liberal Free Trial Plan

THE BRICTON MFG. COMPANY
65 Bricton Building
BROOKINGS, SO. DAK.

Mail Back This Coupon

Bricton Mfg. Co., 265 Bricton Bldg., Brookings, So. Dak.

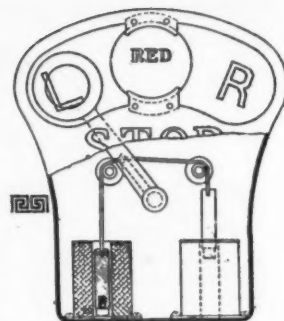
Please send me full particulars about Bricton Tires, explain your free trial plan, also explain how my own tires can be rebuilt the Bricton Way.

Size of Tires _____

Name _____

Address _____

Can You Imagine What It Would Do To Your Car To Have The Car Behind Smash Into It, And Can You Imagine What It Would Cost To Repair It, How It Would Permanently Disfigure Your Car, And How Troublesome And Impossible It Would Be To Collect Any Damages?



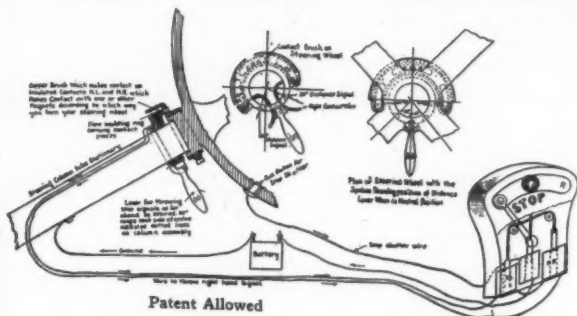
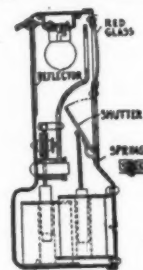
But you can avoid this kind of most prevalent accident by equipping your car with

Pomeroy's AUTOMOBILE REAR SIGNAL Indicator

Automatically Controlled by the Steering Wheel

This simple electrical device automatically registers your turns right and left, telling the man behind what you intend to do, and it also provides a simple control lever on the steering wheel with which you can indicate your intended movements before you make them. With a button on the steering wheel you flash the word "STOP!"

This durable and handsomely constructed device contains the red light required by law, carries your number plate and illuminates it, and furnishes the most needed insurance on the rear end of your car.



We will be pleased to tell you all about this simple device if you will ask us.

The Price is \$12.00 Complete

B. H. Pomeroy, M.E., 10 Jones Ave., Rochester, N.Y. Patents Pending

To The Manor Born

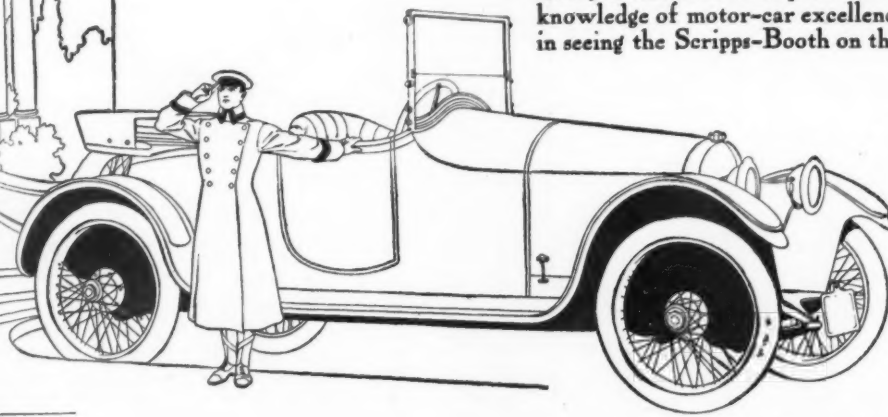


WITH all dignity and road authority, with all beauty and silence of operation, with all the caprices of appointment of the exclusive and expensive large cars, the Scripps-Booth has its unquestioned place in the aristocracy of motordom.

For the first time a light car has been admitted as the social and mechanical equal of the world's largest and highest priced cars.

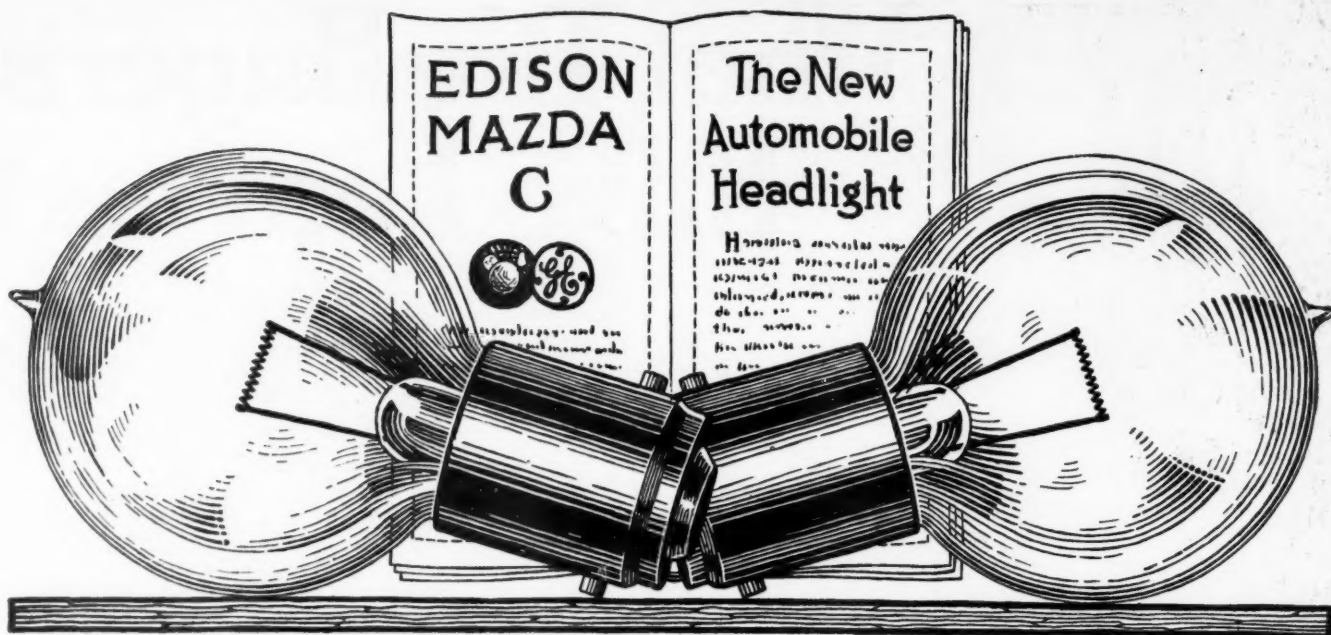
Owners of these large cars are the ones who are especially appreciative of Scripps-Booth design as giving them their first opportunity to secure in light weight what they have always had in large cars.

Every motorist of consequence and every man based in knowledge of motor-car excellence will be interested in seeing the Scripps-Booth on the nearest salesfloor.



Scripps-Booth Co.
Detroit, Mich.

Please mention The Automobile when writing to Advertisers



40% More Light with no Increase in Current Consumption

The development of this new lamp, utilizing the advantages of an inert gas instead of a vacuum, makes it by far the most efficient automobile lamp we have ever produced. This 2½ ampere MAZDA C lamp, for 6-7 volt circuits, gives about 21 candle-power as compared to 15 candle-power for the corresponding vacuum lamp. The light is not only more powerful, without increased glare, but also whiter and of a better quality.

Moreover, the bulb blackens less rapidly thus giving the lamp a longer useful life in service.

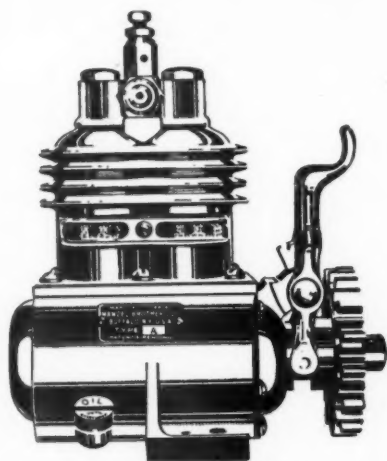
Thousands of motorists already are using the new lamp and the rapidly increasing demand almost exceeds the supply. Miniature lamp agents must be able to supply this demand and should send in their orders at once.

This lamp is supplied also in 24 candle-power size, 1½ amperes for 12-14 volt circuits. The 6-7 volt lamp lists at \$0.35 and the 12-14 volt lamp at \$0.37.

EDISON LAMP WORKS

OF GENERAL ELECTRIC COMPANY

HARRISON, - - - N. J. 5518



We carry in stock fittings for the following cars:

Abbott-Detroit, Buick, Cadillac, Cartecar, Case, Chandler Six, Chalmers, Cole, Dodge, E.M.F., Eger, Franklin, Grant, Hudson, Imperial Six, Jeffery, Kissel-Kar, Maxwell, Michigan, Mitchell, Moon, Oakland, Oldsmobile, Overland, Packard, Paige-Detroit, Rambler Cross Country, Reo, Simplex, Speedwell, Studebaker, Stutz, Velle, Westcott and others. Also for Lippard Stewart, Stewart and Buick Trucks.

MANZEL BROS. CO.,

New York Office—U. S. Rubber Bldg., Broadway & 58th St.

Factory and General Sales Offices:

Portland, Oregon, Office—213 Gerlinger Building.
DISTRIBUTORS IN ALL IMPORTANT CENTERS

308 Babcock St., Buffalo, N. Y.

San Francisco Office—356 Market St.

MANZEL FORD MODEL

For Ford Cars there is a Manzel Engine-Driven Pump that is absolutely ideal from every standpoint—design, workmanship, ease of installation, durability and price. Complete with 12 feet of air hose, gauge and gears.

\$7.50

When you've been caught on the highway with a flat tire—

And you've fussed and fumed and double-dashed the ditch-digging labor of inflating it with a Noah's ark hand pump—then is the time to install a

MANZEL ENGINE-DRIVEN TIRE PUMP

The Manzel Two-Cylinder Pump is a device that is giving unqualified satisfaction on the cars of thousands of motorists the country over. It is not a "talking-point" pump, or a hastily-contrived, poorly-made accessory that is designed to sell at a price to a disgruntled motorist when his back is sore and his hands are blistered and "anything will do."

It is a correctly designed pump that does its promised work without failing once throughout its long life. It is "built like a battleship," machined as well as your motor's finest part—and considering its serious, durable appeal to motorists who know, it is priced far below any other pump of equal quality.

\$20 Complete with all fittings, including 15 feet of air hose, and pressure gauge that is always accurate



What Tire Buyers Have Learned

- and
What It
Means To
Firestone
Dealers

CAR-OWNERS now have a much larger and far more accurate knowledge of tire structure and real tire values than formerly.

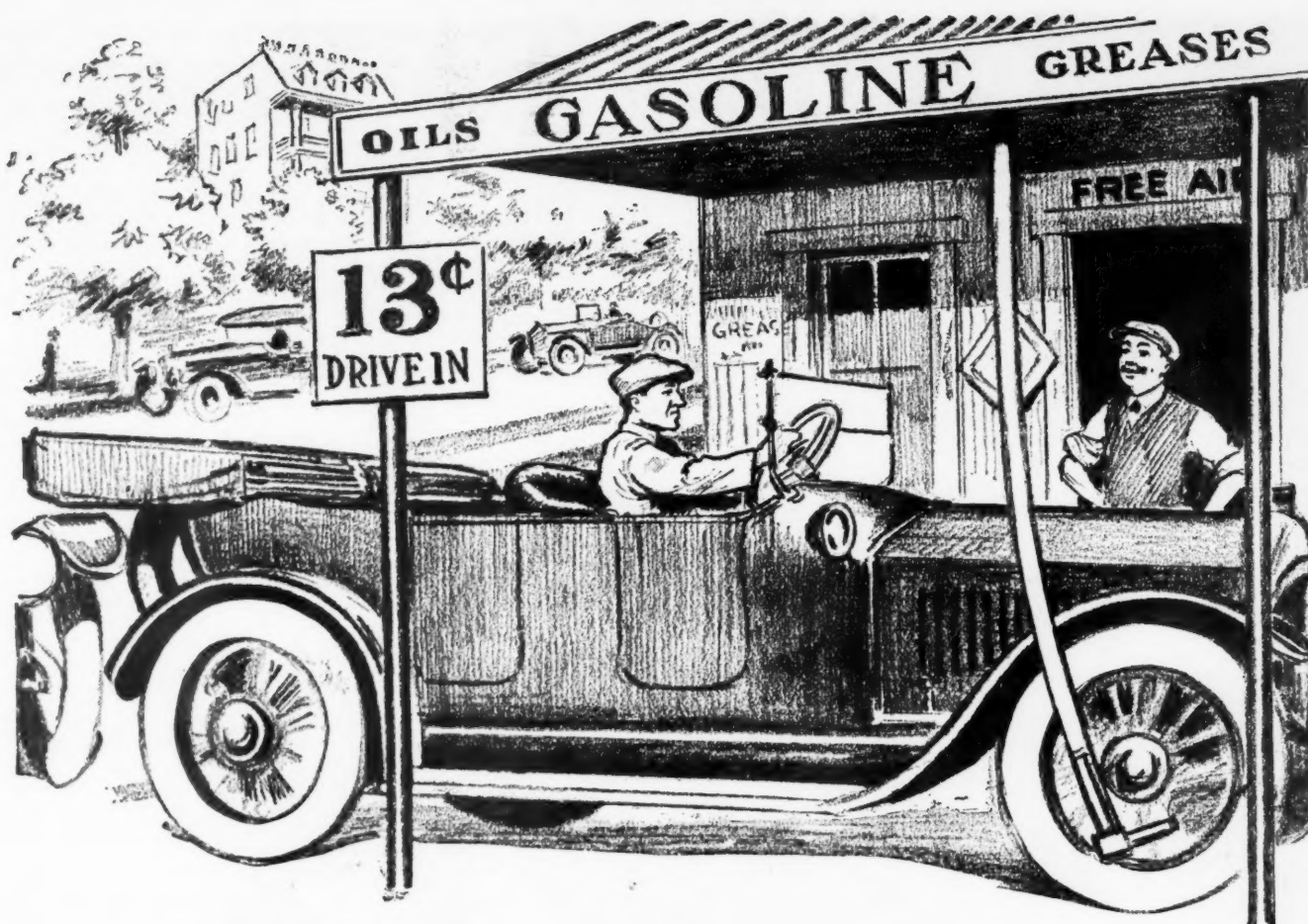
This is one result of the Firestone's tire-section advertising. In Firestone advertisements for months, illustrations of cross sections of Firestone tires in full size have appeared, with the Firestone's Inbuilt Extras so indicated that even the casual observer could readily see them.

The value of this clear light on tires both to car owners and tire dealers is beyond estimate. It has led buyers to insist that everything shall be in a tire that ought to be there—that means Firestones.

They insist on extra plies of fabric—extra coating of rubber between fabric layers—the rubber cushion layer—extra tread built up in center—extra cohesive strength of beads. They demand tires vulcanized by the "two-cure" process. All these demands are met by the Firestone exclusively. The section shows them. The mileage proves them.

The Firestone dealer has an enviable advantage. Through study of the sections, tire buyers are selling Firestone tires to themselves. This explains why so many car-owners are turning to the tire that gives Most Miles per Dollar.

Firestone Tire & Rubber Co., Akron, Ohio—Branches and Dealers Everywhere
"America's Largest Exclusive Tire and Rim Makers"



His Best Customer

A Cast Iron Argument for Aluminum

It isn't the number of cylinders that determines the gasoline consumption of a motor car. And the amount of oil used doesn't depend on the car's size.

Slowly the car buyer learns these things and becomes a firm exponent of the cars in which there is a liberal use of aluminum. The men who make cars, regardless of price, are striving towards a reduction in weight because the public doesn't want to pay transportation charges on cast-iron. It may cost the maker less per pound, but it costs the car owner more per gallon.

One of the big factors in increasing the use of aluminum has been the development of LYNITE aluminum foundry practice which assures the saving

in weight at no sacrifice of strength. In this respect, LYNITE aluminum is playing an important part in the motor car industry.

Already used for between thirty and forty motor car parts, LYNITE is increasing in use because it has established a reputation for performance. This reputation is founded upon one fact—LYNITE castings are made after a particular pattern for a particular part. The requirements of the metal for that particular part are carefully

studied, and the casting is produced under the sleepless eye of technical control of the most advanced foundry practice. Each LYNITE casting is as much a specially designed part of its car as the motor or transmission.

A complete list of parts where LYNITE may be used will be mailed free at your request

THE ALUMINUM CASTINGS COMPANY

LYNITE and LYNEX Castings

CLEVELAND

DETROIT

BUFFALO

MANITOWOC, WIS.

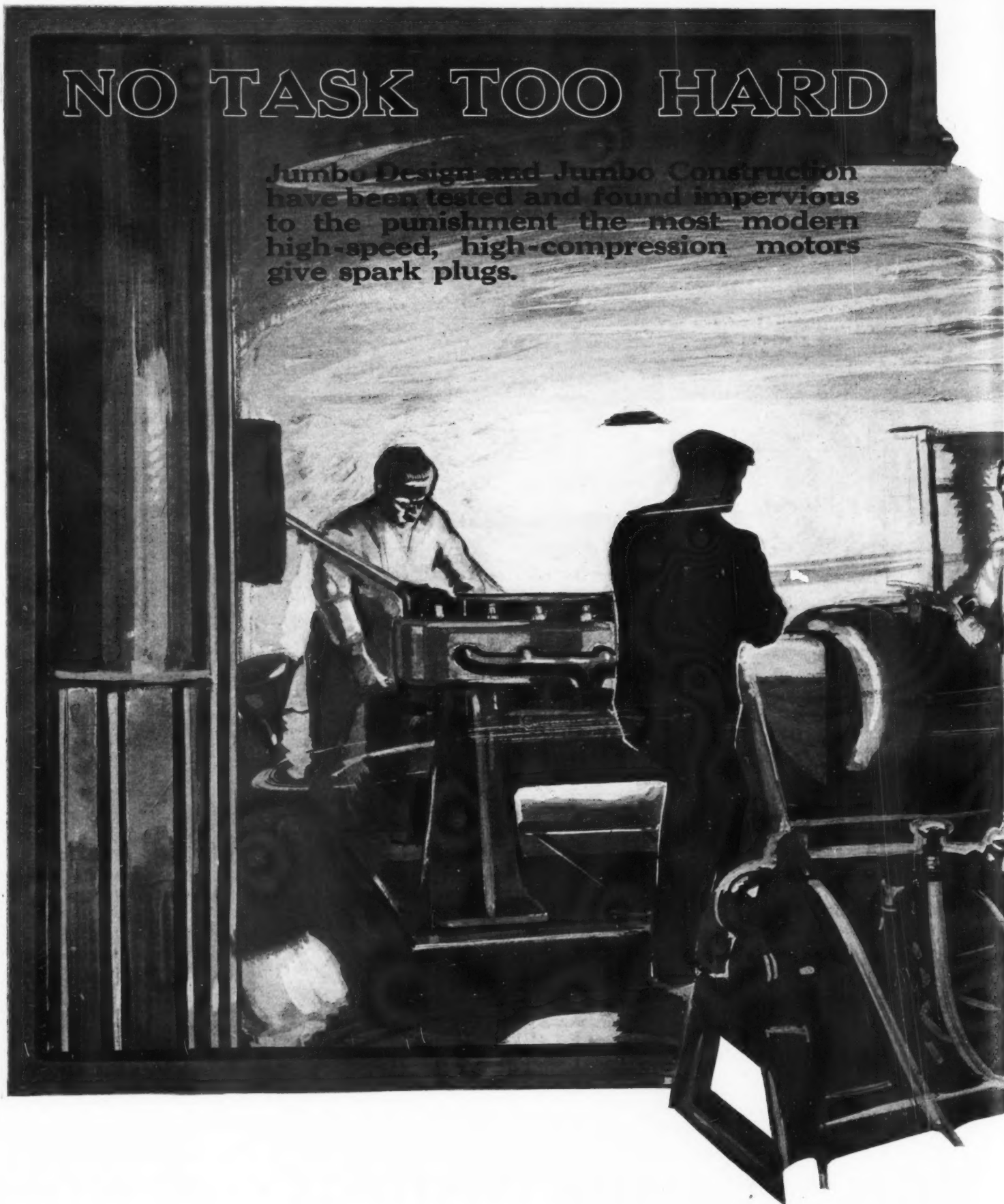
FAIRFIELD, CONN.

Address correspondence to 6201 Carnegie Avenue, Cleveland, Ohio

Please mention The Automobile when writing to Advertisers

NO TASK TOO HARD

Jumbo Design and Jumbo Construction have been tested and found impervious to the punishment the most modern high-speed, high-compression motors give spark plugs.



Gibson-Hollister Manufacturing Company,

Please mention The Automobile when writing to Advertisers

The evolution of their design
—the selection of materials
and the determination of the
results

JUMBO



SPARK PLUGS

will give is more like the work put in on the development of a motor than anything else. Probably no other spark plug on the market can boast of having dynamometer and road tests check up and determine the relative value of each detail of its design—each stage in the development of its porcelains—each method of making it gas tight—rust proof—heat proof—self cleaning, etc.

Nothing has been overlooked in JUMBO PLUGS' design, materials

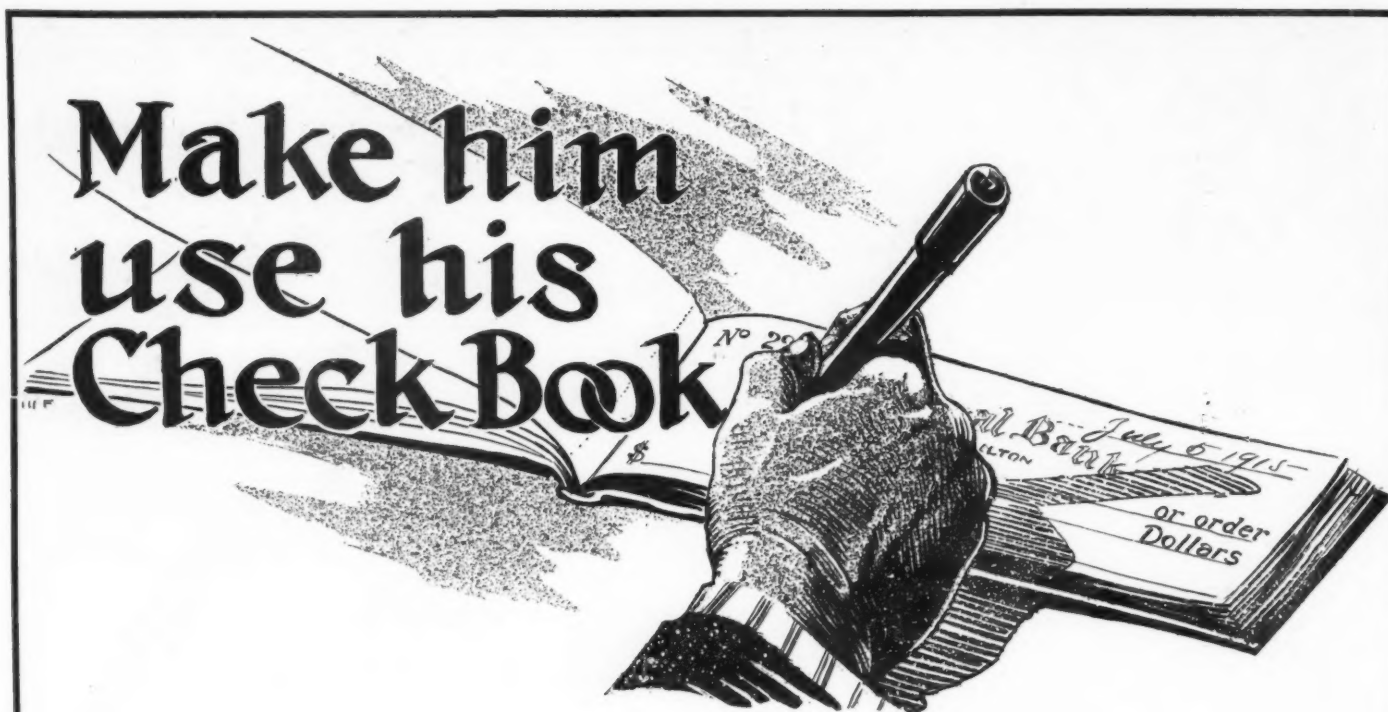
or assembly—that modern laboratory science could suggest, and practical testing—on the block—on the road—under bad conditions as well as under good conditions, could develop.

JUMBO SPARK PLUGS are as good as engineering science and skilful manufacture can make them and the service they give is worth many times the difference in price may seem to indicate.

3380 Washington Ave.,

Boston, Mass.

Please mention The Automobile when writing to Advertisers



Advertisers who make proper use of Motor World have a decided advantage with the worth while garagemen, dealers and jobbers throughout the United States.

Thousands of them subscribe for and read Motor World because it is *their* paper—designed and edited for the advancement of *their* business.

The wide-awake merchandisers of the industry—the men who sell cars, trucks, accessories, supplies and service—are learning more and more to depend upon Motor World for guidance and instruction.

Reach this army of purchasing units with your message.

Show them how to increase their money-making opportunities.

Every Motor World subscriber is a possible purchaser, in a whole-sale way, of your product. There is no waste circulation.

You have a message. We will provide the audience that can purchase your season's output.

Considering the service rendered our advertising rates are low.

A copy of "Economy in Industrial Advertising" will be sent free and postage paid to any manufacturer or jobber who will address:

MOTOR WORLD

The Dealers' National Weekly

239 West 39th Street, New York

Please mention The Automobile when writing to Advertisers

GURNEY



THIS NAME ON A
BALL BEARING MEANS
CAPACITY AND ENDURANCE.

These qualities depend upon a number of things.

A highly perfected design which makes possible a full complement of balls of maximum size without sacrificing thrust capacity by filling slots.

Unequaled perfection of race contour to give to every ball its greatest possible capacity and ensure its longest life.

The best obtainable steel.

The steel given the best heat treatment that the latest metallurgical science knows.

All checked by the most drastic system of inspection.

All this the culmination of fourteen years of patient and laborious specialization on just this one thing.

Gurney Ball Bearing Company

JAMESTOWN, NEW YORK, U. S. A.

DETROIT AGENCY: Dime Bank Building.

NEW YORK AGENCY: No. 2 Rector Street



Please mention The Automobile when writing to Advertisers



**FEDDERS
RADIATORS**

F

**Fedders Manufacturing
Facilities**

are so well organized that all delivery requirements—of standard or special design cooling systems—are made exactly to schedule.

Such an advantage as our ability to meet the most rigid requirements at all times and at no sacrifice in the quality which has made

Fedders Radiators

famous, is the basis of our solicitation of your business.

Fedders Manufacturing Co., Inc.
BUFFALO, N. Y.

Please mention The Automobile when writing to Advertisers

Battery service that IS service


- First:** Every Gould Automobile Battery is guaranteed to give thorough satisfaction, and if not fully justifying every claim will be replaced with liberal readjustment on the price of a new battery.
- Second:** Gould Service Stations and representatives all over the country are instructed to cooperate with our customers in keeping Gould Batteries **constantly** in best possible condition.
- Third:** The Gould Guarantee is backed by a perfect organization with millions of dollars invested in plant and equipment, established for 15 years and second to none for engineering ability, business integrity and liberal treatment of patrons.

We are the **first** and **only** battery manufacturers to offer a protective guarantee on batteries of starting and lighting types.

Car builders will equip your new car with Gould Guaranteed Battery if you **insist**; or if the battery on your present car is faulty, a Gould Guaranteed Battery exactly meeting electrical requirements and fitting your battery box can be installed by any repair shop.

Avail yourself of this protection.





Gould Storage Battery Co.

1 Office 20 E 42nd St. New York

BOSTON—347 Newbury St.
PHILADELPHIA—613 Lincoln Bldg.
CLEVELAND—1761-65 E. 18th St.
DETROIT—Kerr Bldg.
CHICAGO—225 E. 22d St.
SAN FRANCISCO—1448 Van Ness Ave.
LOS ANGELES—118 E. Pico St.

Agents in Washington, Rochester, Buffalo, Pittsburgh, Milwaukee, Minneapolis, St. Paul, Kansas City, Omaha, Denver, Topeka, Seattle, Canadian Representative: R. E. T. Pringle, Toronto, Montreal, Winnipeg, Vancouver.

Full Stock of parts, plates and repairs carried by all offices and agents

Works at Depew, N.Y.

MULTIBESTOS CLUTCH LININGS



Exact in Dimension. Perfect in Form.

A close, solid weave of pure asbestos forms a basis for the strength of Multibestos Clutch Facings.

After being woven, the facings are impregnated with an oil-proof compound and compressed under a pressure of twenty thousand pounds to the square inch.

A rigid inspection follows each facing thru each process of manufacture with the result that Multibestos facings—for either cone or disc clutches—are always exact in dimension and perfect in form.

Standard Woven Fabric Co., FRAMINGHAM, MASSACHUSETTS

New York Branch and Export Offices, 1779 Broadway

Boston: F. Shirley Boyd, 175 Massachusetts Avenue.

Chicago: F. E. Sparks, 1430 Michigan Blvd.

Philadelphia: N. A. Petry Co., Inc., 1309 Race Street.

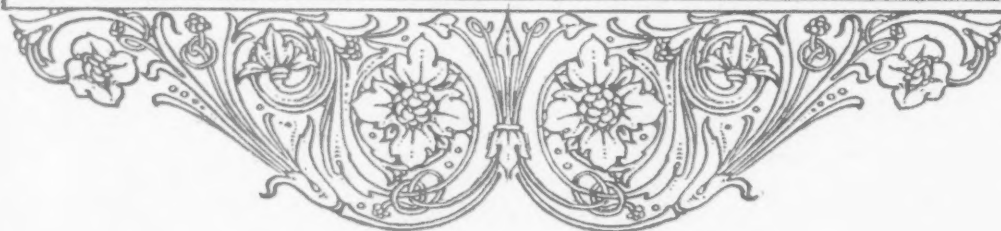
San Francisco: Fred Ward & Son, Inc., Cor. First & Howard Streets.



PRICE of the
Packard
"TWIN-SIX"

the most sensational car
of the season, includes as
regular equipment, the
most expensive accessory
of its kind — a

WALTHAM
AUTOMOBILE CLOCK



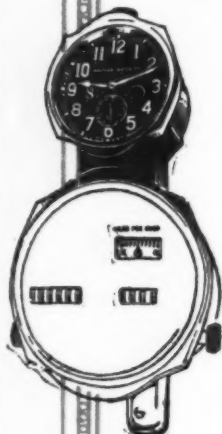
WALTHAM

WATCH

COMPANY



ALTHAM 8-day multi-jeweled timepieces are selected as stock equipment for most of America's finest cars. The following is a partial list:



*Special Packard
Model for Twin-
Six Dash*

ANDERSON (Electric)	BREWSTER
CADILLAC (New Limousine)	CRANE
HAYNES	HOLBROOK
JEFFERY	LOCOMOBILE
LOZIER	MARMON
OWEN-MAGNETIC	PIERCE-ARROW
RAUCH & LANG (Electric)	ROLLS-ROYCE
SIMPLEX	STEARNS (New Model)
	WINTON

Waltham Automobile Clocks are not only the best instruments ever devised for motor car usage, but they also have all the outward beauty which characterizes our fine timepieces.

The car manufacturer who thinks enough of the equipment on his car to use so choice an instrument as the WALTHAM Automobile Clock is likely to have used the same sagacity and expenditure in purchasing other requisites.

You can obtain a WALTHAM Clock on your new car by a friendly insistence at the time of purchase.

They have a warning signal which notifies 3 days before the clock runs down, thus avoiding the necessity for resetting.



*Special Model for
Packard Enclosed
Bodies*

WALTHAM

WATCH

COMPANY



If Your Car "Rides Hard"— When Your Spring Breaks—

—Remember

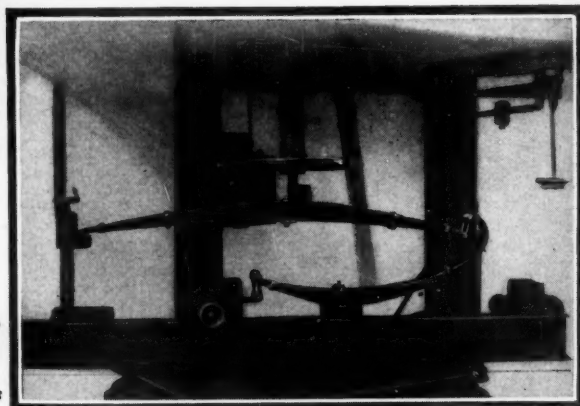
No matter how low priced your car may be, Sheldon Springs are commercially practical as equipment. For while in a few isolated cases first cost may be a little higher, the difference is so slight as to be unworthy of consideration.

And on the other hand in the majority of cases Sheldon Springs will show the car maker an absolute saving in cost, compared with any other springs manufactured. In each case, irrespective of cost, they will show length of life from a minimum of 50% upwards over any other springs that can be purchased.

*Partial view of one
of the forging depart-
ments*



*View of one of the
finishing rooms*



*Seven-eighths floating scroll elliptic mounted in
testing machine*

THE SHELDON AXLE & SPRING COMPANY

Makers of Springs and Axles for Heavy Duty Service for More Than 50 Years

WILKES-BARRE, PENNSYLVANIA

Chicago: 122 S. Michigan Blvd. San Francisco: 444 Market St. Detroit: 1215 Woodward Ave.

"Exhibiting Section 16, Transportation Building, Panama-Pacific Exposition, San Francisco."

Service we give Users of *Stewart*

No matter where you are, or go, you get this Expert "Service"

OVER 1,700,000 loyal supporters, who are using one or more Stewart Products on their cars every day all over America know how wonderfully satisfactory it is when at home, or touring, to be able to drive up to a Stewart Branch or Service Station where an expert is always ready to adjust any difficulty.

No other manufacturer of Automobile Accessories gives such universal service as this. You will find dealers out through the country who sell the car that you drive, and they will do everything possible for you. But they cannot give service to the accessories your car carries like Stewart Service, because car dealers are not equipped to render this service the way Stewart Branches and Stewart Service Stations are always equipped to take care of you.

Very few accessory manufacturers even pretend to maintain service stations or branches. If anything goes wrong with their product on your car, delays are necessary for you to ship such parts or accessories to their factory

for repair or adjustment. This is always a serious inconvenience, besides being a great nuisance, and expensive.

On the other hand, when you drive up to any Stewart Branch or Service Station you are dealing directly with the Stewart organization.

If you need information, advice or assistance at any time in regard to any Stewart Product on your car, or any other help, you will always find the experts at these Stewart Branches and Service Stations at your command.

Branches and

88

Stewart



**to
Pacific**

HOUSTON, TEXAS.
NASHVILLE, TENN.
MEMPHIS, TENN.
GALESBURG, ILL.
EVANSTON, ILL.
AUSTIN, ILL.
DULUTH, MINN.
MINNEAPOLIS, MINN.
ST. PAUL, MINN.
INDIANAPOLIS, IND.
DAVENPORT, IOWA.
DES MOINES, IOWA
CEDAR RAPIDS, IOWA
GRAND RAPIDS, MICH.
FORT WAYNE, IND.
MILWAUKEE, WIS.
ST. LOUIS, MO.
KANSAS CITY, MO.
WICHITA, KAS.
ALBUQUERQUE, N. MEX.
DENVER, COL.
FARGO, N. DAK.
NEW ORLEANS, LA.
OMAHA, NEB.
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RENO, NEVADA.
SALT LAKE CITY, UTAH.
BAKERSFIELD, CAL.
FRESNO, CAL.
LOS ANGELES, CAL.
SAN FRANCISCO, CAL.
OAKLAND, CAL.
SACRAMENTO, CAL.
SAN DIEGO, CAL.
PORTLAND, OREGON.
SEATTLE, WASH.
SPOKANE, WASH.
TACOMA, WASH.
CALGARY, ALBERTA.
VANCOUVER, B. C.
WINNIPEG, MAN.
SASKATOON, SASK.
REGINA, SASK.



**Stewart Magnetic
Speedometer
\$25 and up**

to the 1,700,000 Products

from
Atlantic

Service Stations

PORTLAND, MAINE.
BOSTON, MASS.
WORCESTER, MASS.
SPRINGFIELD, MASS.
PROVIDENCE, R. I.
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ALBANY, N. Y.
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NEW YORK CITY.
TRENTON, N. J.
NEWARK, N. J.
ATLANTIC CITY, N. J.
ATLANTA, GA.
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ERIE, PA.
PITTSBURG, PA.
YOUNGSTOWN, OHIO.
CLEVELAND, OHIO.
COLUMBUS, OHIO.
CINCINNATI, OHIO.
LOUISVILLE, KY.
DETROIT, MICH.
TOLEDO, OHIO.
LONDON, ONT.
TORONTO, ONT.
CHICAGO, ILL.
DALLAS, TEXAS.
EL PASO, TEXAS.
SAN ANTONIO, TEXAS.

Wouldn't it
be wonderful if
your car carried
even more products
on which you could get
service like *Stewart* Service?

STEWART-WARNER SPEEDOMETER CORPORATION

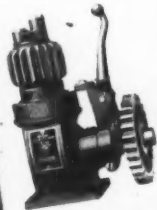
Executive Offices: 1930 Diversey Boulevard, Chicago.

Factories: Chicago and Beloit, U. S. A.

15 BRANCHES—Boston, Buffalo, Chicago, Cleveland, Detroit, Indianapolis, Kansas City, Los Angeles, Minneapolis,

New York, Philadelphia, St. Louis, San Francisco, London, Paris.

78 SERVICE STATIONS IN ALL CITIES AND LARGE TOWNS.



Stewart Motor-Driven Tire Pump

Complete with 15 feet
of high-grade hose, air
gauge, bracket, gears,

\$15



Self Winding ELECTRIC Clock

Installed with dry cell
or connected with
your electric system,

\$15



Stewart Vacuum Gasoline System

\$10

Warner Auto-Meter

"The Aristocrat of
speed indicators"

\$50 and up



Please mention The Automobile when writing to Advertisers

"This—and—that" advertising

is not carried in

MOTOR AGE

Hit-or-miss publicity is excluded from our columns. And every piece of advertising copy we accept must be a message to *real motorists*.

Our readers appreciate the directness of this service. They depend upon us for guidance in all purchase directions. We value their confidence, and strive to merit it.

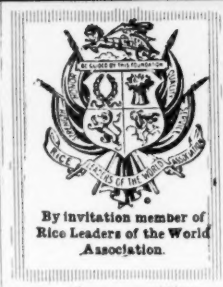
The magazine whose readers say: "If it's advertised in Motor Age it's good enough for me" is assuredly worth the patronage of all manufacturers in the industry.

To purchase space in this magazine is not an experiment—it's a long step toward permanent success.

Advertising rates will be sent promptly upon request. Address:

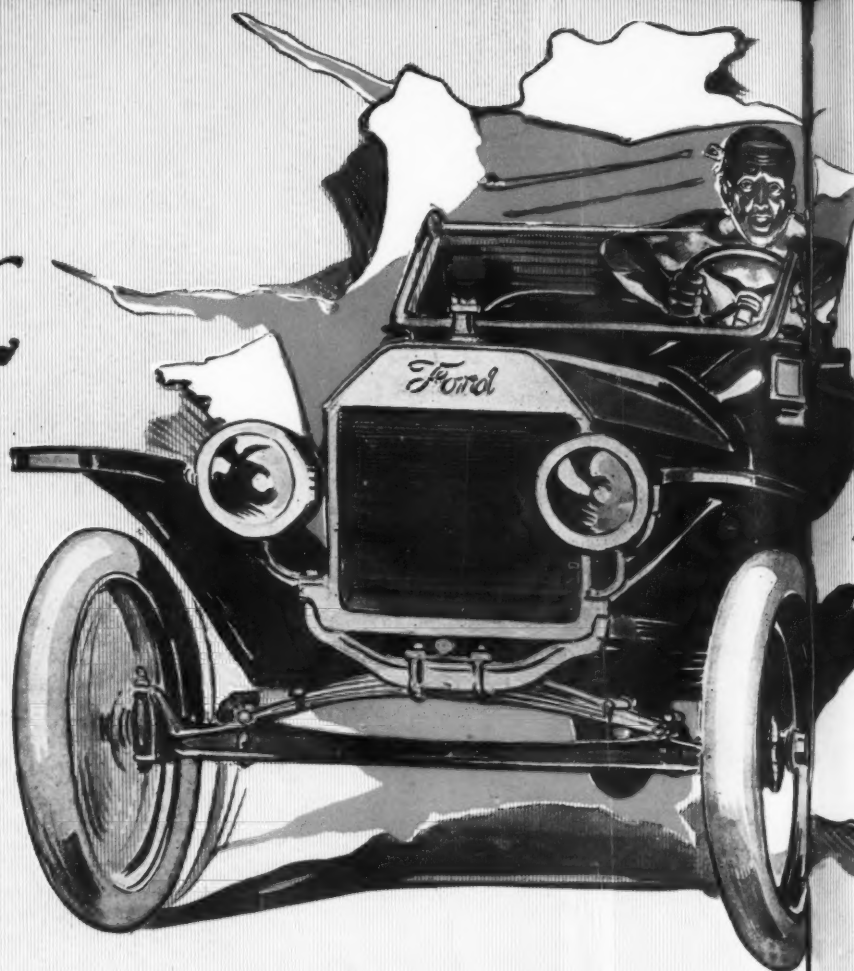
MOTOR AGE

910 South Michigan Avenue, Chicago



The most startling
announcement ever
made in the FORD
starter field.

The Splitdorf- APELCO Single Unit System



Developed, Built and Guaranteed by the
Largest Exclusive Manufacturer of Au-
tomobile Electrical Devices in the World

Realizing the tremendous demand on the part of Ford owners for a high grade electrical starting and lighting system, we built a remarkably perfect system for this purpose—THE SPLITDORF-APELCO SINGLE UNIT SYSTEM.

The unequalled facilities of the SPLITDORF ELECTRICAL COMPANY, together with the APPLE ELECTRIC COMPANY, now a part of the great SPLITDORF-APELCO ORGANIZATION, made it possible to carry on that experimental development work on the largest, most comprehensive and scientific scale.

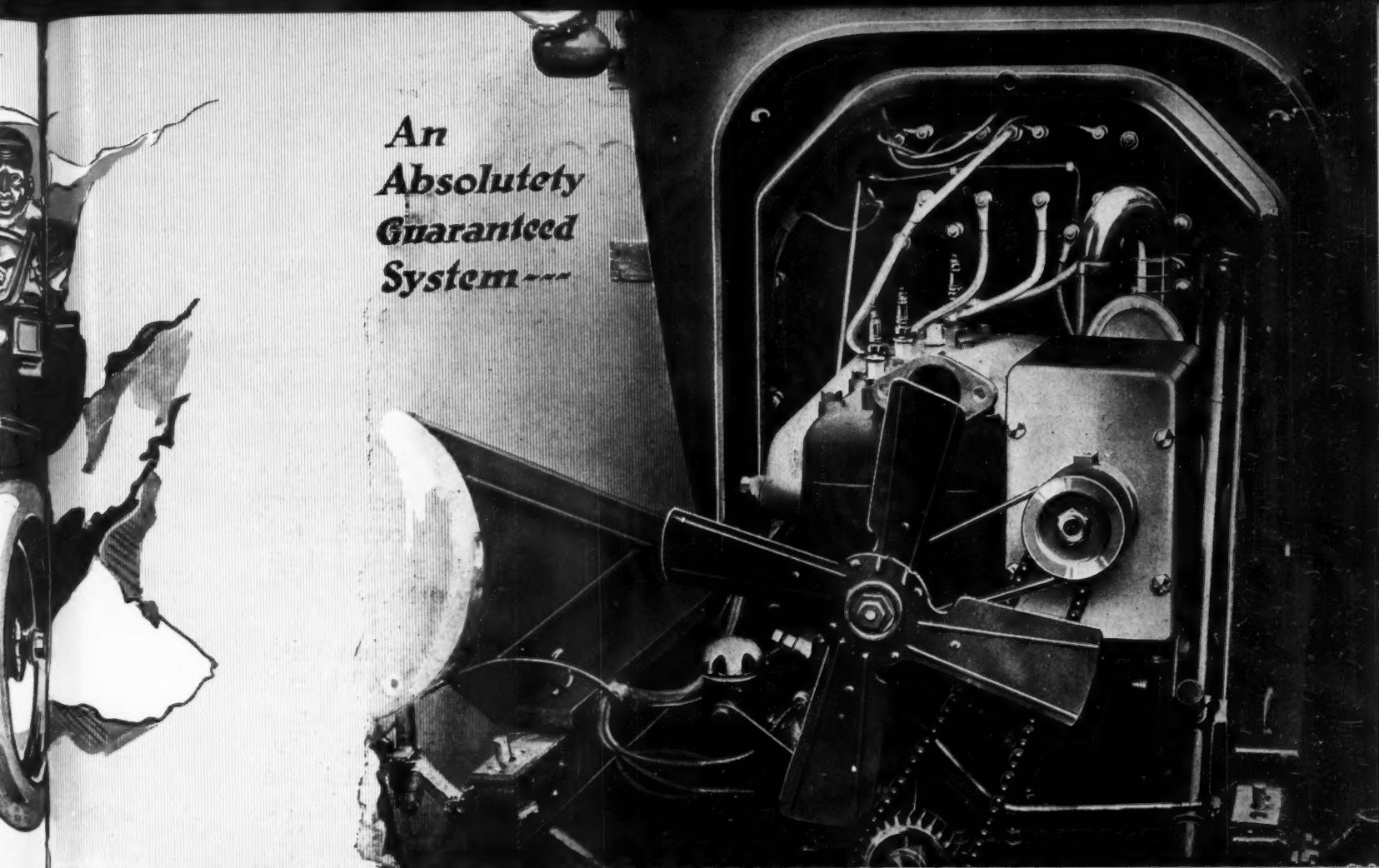
Two years ago our preliminary work was almost completed. Yet through all this period, before beginning actual manufacturing operations, this system was subjected to the most rigorous tests and abuse in order

to discover, if possible, any hidden weakness, or to find any means of improvement.

When the system was completed it was discovered that its expensive character dictated a retail price of \$85, at which price we expected to market it. But the tremendous demand, the volume production and the new method of marketing direct to dealers have made it possible to reduce that figure to \$65.

Now that our manufacturing facilities are in perfect shape and we are ready to make immediate deliveries, we announce the NEW SPLITDORF-APELCO SINGLE UNIT SYSTEM, confident that it is without a peer, and that it embodies a greater sum of starting-lighting essentials and more features of practical value than any other starting and lighting system ever developed for Ford cars.

An Absolutely Guaranteed System

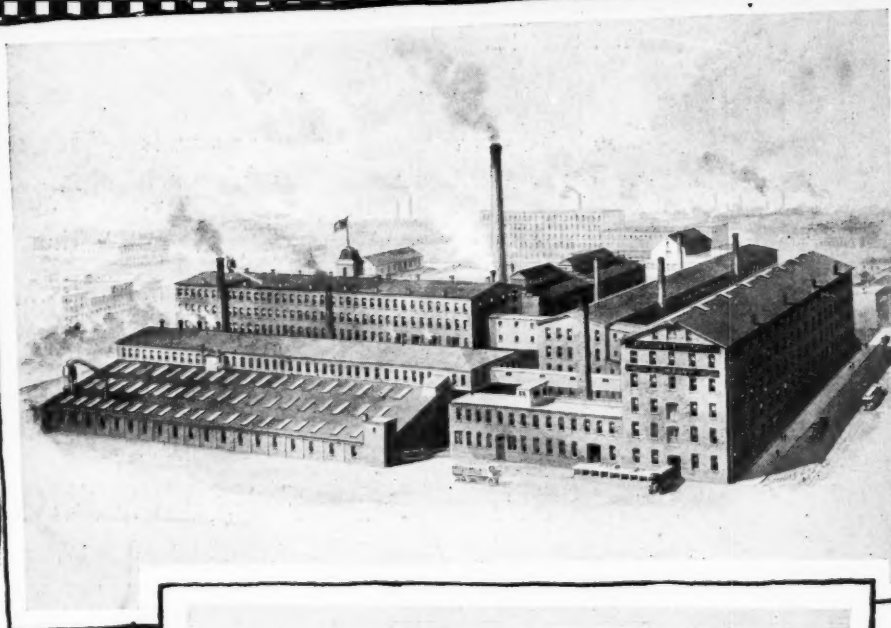


Things to Remember About the Splitdorf-Apelco Single Unit System

- 1—As a motor, the SPLITDORF-APELCO SINGLE UNIT SYSTEM is powerful enough, at economical current consumption, to spin the engine at sufficiently high speed to insure prompt and unfailing starting.
- 2—Working as a generator, this system is capable of producing ample current output at low speeds to maintain a fully charged battery, and provide for every current demand.
- 3—It has perfect current control at all speeds, eliminating the danger of an undercharged or an overcharged battery.
- 4—In line with the car on which it is designed to work, the SPLITDORF-APELCO SINGLE UNIT SYSTEM combines substantial construction with light weight—the lightest construction consistent with the work it has to do.
- 5—The installation of this system is extremely simple and once installed it gives the greatest accessibility and does not need to be removed for the ordinary repairs a Ford motor may require.

The SPLITDORF-APELCO SINGLE UNIT SYSTEM is the easiest to apply to a Ford car. Every provision has been made so that the original price of this system includes everything and so that the Ford owner has no additional expenses—all for \$65.

Then, by way of good measure, add the reliability of SPLITDORF-APELCO PRODUCTS, the completeness of SPLITDORF-APELCO SERVICE, and the enviable reputation of the SPLITDORF-APELCO ORGANIZATION for fair dealing.



The SPLITDORF- APELCO SYSTEM *is* RIGHT

The SPLITDORF-APELCO ORGANIZATION is the largest exclusive manufacturer of automobile electrical devices in the world. SPLITDORF-APELCO PRODUCTS have gained their fame by their efficiency, reliability and practical worth.

This reputation, together with our unlimited co-operation with the dealer to make our relations satisfactory and happy, should be the greatest inducement for the dealer's equipping his customers' Fords with the SPLITDORF-APELCO SYSTEM. The convenience with which the dealer can immediately obtain these devices from our many branches and service stations should be another inducement. And the fact that he may make **all the profit** instead of dividing with a territorial distributor, makes the SPLITDORF-APELCO SYSTEM the only system he can afford to handle.

The Ford owner, who, like thousands of other car owners, puts his confidence in SPLITDORF-APELCO PRODUCTS, is not only a wise man in that he is selecting the article which will give him the most continuous and satisfactory service—but he gets the device which involves no expense

for its installation and maintenance.

The dealer who prepares to handle this best and most needed Ford necessity need not invest a dollar. He may get the system he sells immediately, install it in the shortest time, and make all the profit himself.

SPLITDORF ELECTRICAL COMPANY

BRANCH HOUSES AND SERVICE STATIONS

ATLANTA...10-12 E. Harris Street
BOSTON...1112 Boylston Street
CHICAGO...64-72 E. 14th Street
CINCINNATI...811 Race Street
DALLAS...402 S. Ervay Street
DETROIT...972 Woodward Avenue

KANSAS CITY...1827 Grand Ave.
LOS ANGELES...1215 S. Hope St.
MINNEAPOLIS...34 S. 8th Street
NEWARK...290 Halsey Street
NEW YORK...3, 5 and 7 W. 61st St.

PHILADELPHIA...210-12 N. 13th St.
PITTSBURGH...5941 Ellsworth Av.
SAN FRANCISCO...1028 Geary St.
SEATTLE...1628 Broadway
TORONTO...463 Yonge Street

LONDON

PARIS

MILAN

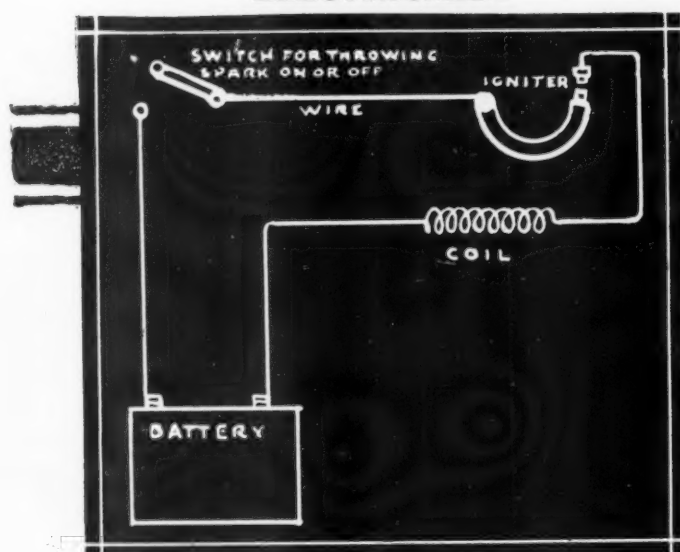


SIMPLICITY

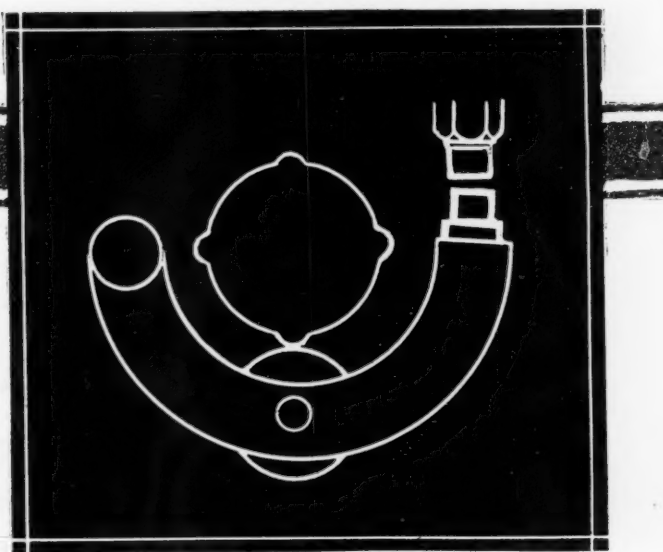
of

CONNECTICUT AUTOMATIC IGNITION

ELECTRICALLY



MECHANICALLY



In ignition, simplicity spells efficiency.

CONNECTICUT AUTOMATIC IGNITION employs the simplest form of circuit—nothing in it to restrain the full flow of current—nothing to impede thorough saturation of the coil. The electrical action is absolutely free from complications and as a result, the slightest indication of electrical lag is present, even under the demands of a twelve cylinder motor working at excessively high speeds. In fact, no electrical lag can ever occur in CONNECTICUT AUTOMATIC IGNITION, because there is nothing in the circuit to cause it.

There is nothing like CONNECTICUT AUTOMATIC IGNITION—in action or results. The magneto circuit is of the same kind but the variable current curtails its efficiency at low speeds.

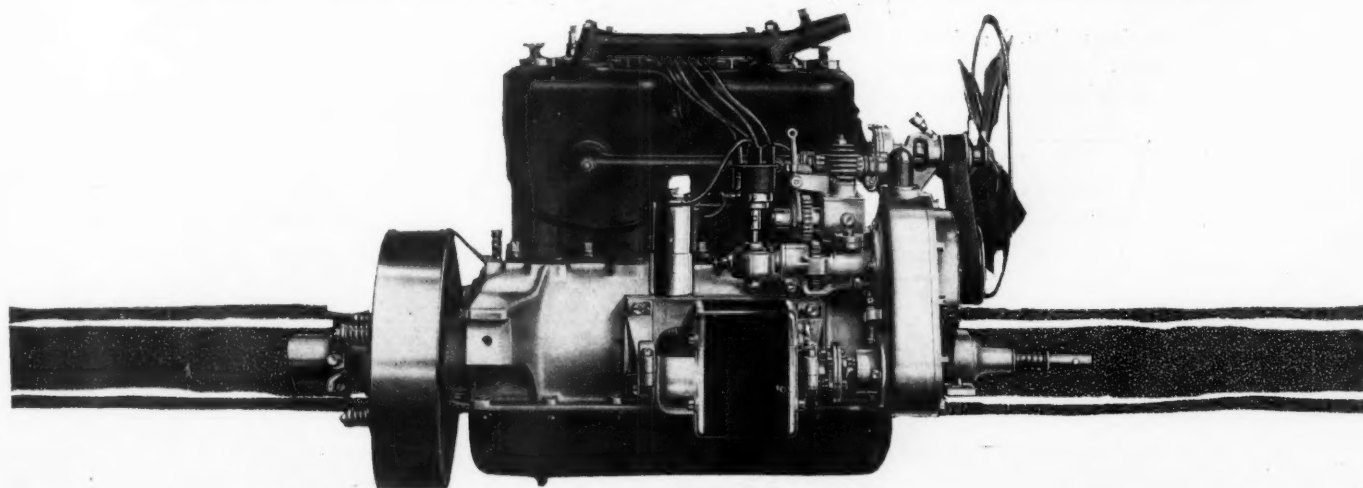
Other forms of ignition have been compelled to sacrifice both the simplicity and efficiency of their systems in order to minimize the danger of battery drainage.

In CONNECTICUT AUTOMATIC IGNITION all mechanical action takes place in the breaker-box. The action which causes the make and break of the circuit is simple, direct and the most positive mechanical action known. It is the only action which eliminates mechanical lag. This is most important, especially in view of the trend toward high speed motors, because mechanical lag, inherent in spring, trigger or relay actions, is fatal to synchronous firing.

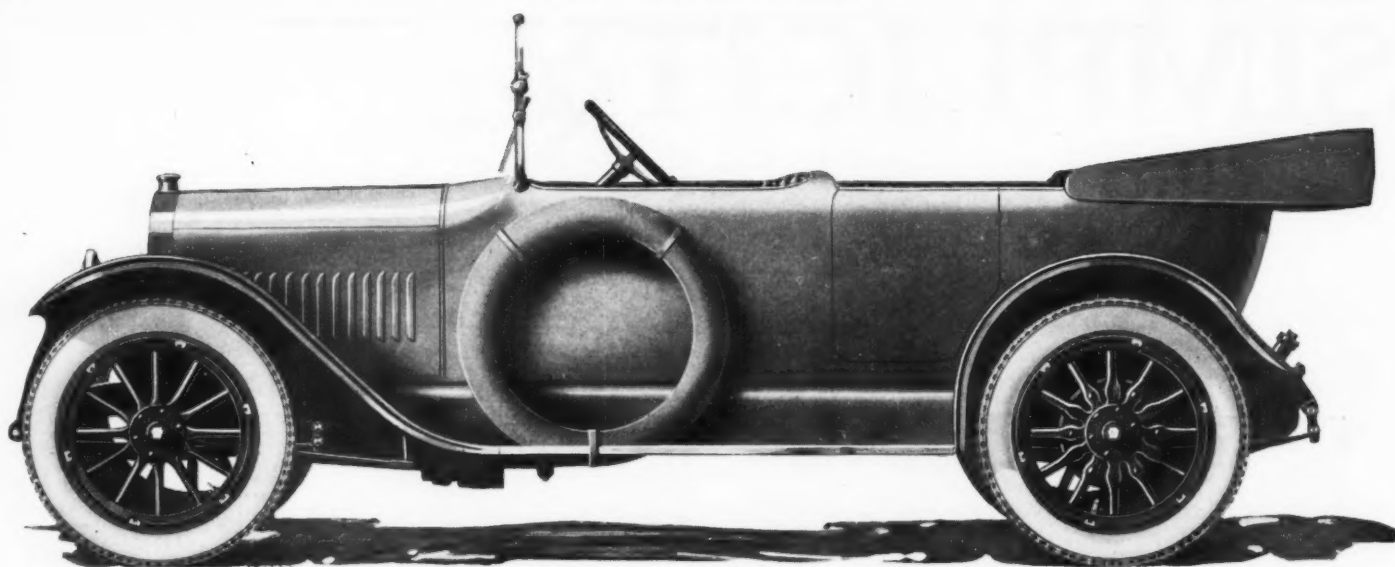
In marked contrast with the limited range of advance and retard due to the mechanical construction of the magneto, the unlimited range of manual control with CONNECTICUT AUTOMATIC IGNITION puts no restriction upon motor flexibility.

As a result of its simplicity CONNECTICUT AUTOMATIC IGNITION not only insures synchronous action at all times, but absolute freedom from mechanical troubles, which make constant service necessary.

Connecticut Telephone & Electric Co., Meriden, Conn.



Please mention The Automobile when writing to Advertisers



"8" Cylinders **"Staggered"—** **and Why:**

The Standard "8" motor has a single cam-shaft with 16 integral cams. The cylinder blocks are staggered sufficiently to allow the connecting rods to line up with the crank-shaft. Thus each connecting rod has its individual bearing on the crank-shaft.

The forked rod-ends of other eight-cylinder motors operating on the double concentric crank-pin bearing have been done away with. Instead, the connecting rods work side by side on the crank-pin and are interchangeable, being "I" section drop forgings of two-bolt cap construction. A force feed oiling system through a drilled crank shaft gives *perfect* lubrication.

Standard "Eight" Specifications

Eight cylinders; 3-inch bore, 5-inch stroke, "V" shape; unit power plant with three-point support. Wheel base, 121-inch; seating capacity, seven passengers; tires, 35x4½, non-skid, front and rear; weight, including oil, gasoline, water and two extra tires, 3200 pounds.

Send For Our Selling Plan

Write today for details of our advertising campaign, now fully prepared, for our Territorial Agreement and for Illustrated Descriptive Folders of Standard Cars. Start now with a Tested 1916 Standard "Eight."

The Standard "Six"

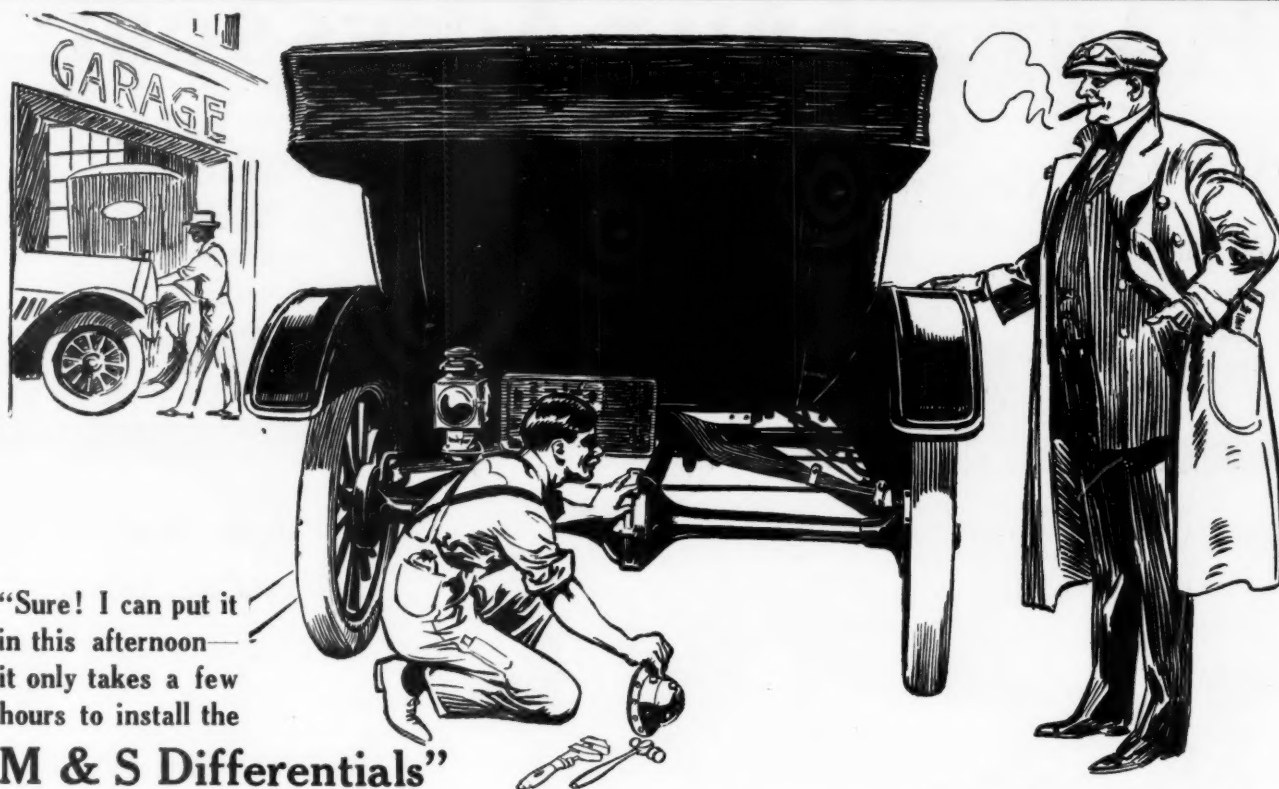
is a larger car, built to combine supreme refinement and great power at a fair price. Six cylinder motor; 4" bore, 5½" stroke; unit power plant with three point support. Wheel base, 126"; tires 36 x 4½; demountable rims; weight 3800 lbs.

Standard Steel Car Co.
Pittsburgh, Pennsylvania



"These Standards are the Measure of Efficiency"

Please mention The Automobile when writing to Advertisers



"Sure! I can put it
in this afternoon—
it only takes a few
hours to install the

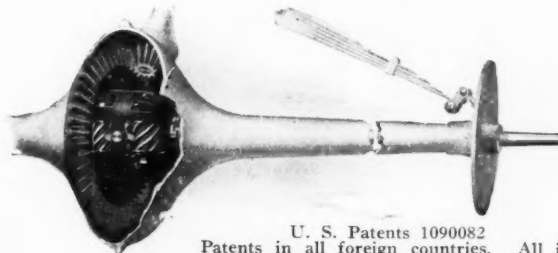
M & S Differentials"

That's the reason Ford dealers and accessory houses are flooding us with orders for the M. & S. Differential—Special Type for Ford cars—fits in the Ford housing, using the regular ring and pinion gears. Think of it! The M. & S. Spiral Gear Differential at only a trifle more than the ordinary Ford Bevel Gear Differential.

Every Ford owner is glad to make the change after he has once driven a Ford equipped with the M. & S. We can furnish special 3½% nickel steel Ring and Pinion Gears—4 to 1 ratio at \$6.50 per set, if desired.



Special Type for Ford Cars



U. S. Patents 1090082
Patents in all foreign countries. All
infringements will be vigorously prosecuted.

"Pulls Both Wheels"

Made for us by the Brown-Lipe-Chapin Co. of Syracuse—the largest makers of differentials in the world—from the same nickel steel and embodying the same principle used in M. & S. Differentials for the high-priced, high-powered cars.

The M. & S. Marks the Biggest Advance in Automobile Building Since the Electric Starter.

The M. & S. Differential insures a positive and equal pull on both wheels at all times. If one wheel has traction and the other does not, the wheel without traction can revolve no faster than the one with traction. In other words, the M. & S. is really an automatic differential lock which operates when a lock is necessary, yet differentiates wheel traveling in turning corners.

All the Power in the World Is No Good if You Have No Traction.

The M. & S. enables you to get out of any mud holes, sand or snow if one wheel has even the slightest traction. By insuring this positive and equal pull on both wheels, you save anywhere from 500 to 1000 miles' wear on the rear tires. You get more mileage to the gallon of fuel and you utilize all your engine power for work and not for idle spinning. The M. & S. transmits the power to the wheel or wheels having traction at all times, thereby minimizing the danger of wheel skidding and lessening the possibility of serious accidents, due to loss of traction by the rear wheels.

The M. & S. Is a Certain Money-maker for Dealers.

Every Ford owner is a prospect. Every demonstration practically means a sale. You have no competition and it's so easy to sell M. & S. Differentials to Ford owners that you can make more money with less expense and effort than you can make selling cars. The cost is only a trifle more than the regular Ford Bevel Gear Differential, yet the advantages of the M. & S. are so obvious that no Ford owner will be satisfied with his present differential when once he has driven a Ford equipped with an M. & S.

To Ford Dealers—We want every Ford Dealer to install an M. & S. Differential in a Ford Car and then drive it in sand and mud and over slippery pavements. Send in the coupon and say you are a Ford Dealer and we will make you a liberal offer on a sample Differential for your Ford.

To any one financially able to handle large territory in a big money-making way, we have an exclusive proposition. It will pay you to investigate.

M & S GEAR CO., 1534 Grand Avenue, Kansas City, Mo.

DISTRIBUTORS: M. & S. Sales Co., 429 So. Ervay St., Dallas, Texas; M. & S. Sales Co., S. E. Cor. Race and Broad St., Philadelphia, Pa.; Hill-Smith Metal Goods Co., 88 Pearl St., Boston, Mass.; M. & S. Sales Co., 936 Woodward Ave., Detroit, Mich.

J-M AUTOMOBILE ACCESSORIES

One Firm One Service
One Guarantee

A three-fold assurance of satisfaction that covers the most complete line of automobile accessories marketed by a single company.

Quality—Value
Responsibility

Three advantages which every car owner enjoys to the utmost who specifies J-M Accessories when in need of equipment for his car.

**JOHNS-
MANVILLE
SERVICE**

**COVERS
THE CONTINENT**

**LONG
HORN**
INVENTED BY C.F. LONG



Do Cheaper Horns Really Pay?

You get just what you pay for when you buy a cheap horn—cheap materials, cheap workmanship and a cheap design. Horn value is more than paint-deep. Know something about what goes into a horn before you buy it.

Ask a Long Horn dealer to show you a Long Horn dis-assembled.

See how perfectly toothed and cut each gear is. And they are hardened machine-cut steel gears and not cheap castings. The vibrator runs on a ball bearing, the diaphragm is made of the best Swedish steel, every part is chosen to give lasting service.

We might have said **EVERLASTING SERVICE**, for a Long Horn is built so well that it lasts indefinitely and is guaranteed permanently against defects in material.

If any part of a Long Horn ever fails, bring back the horn and we'll give you a new one.

That's our guarantee for the Long Horn user's satisfaction.

Booklet on Request

J-M Non-Burn Brake Lining

A true safeguard and a real economy. A tough, closely woven fabric with a sure grip. Can be secured in cartons containing cut sizes.



J-M Auto Clock

Keeps excellent time. Runs 8 days without rewinding. Setting and winding keys concealed. Finished to match fittings of car. Two mountings, flush or dash, each \$5.

J-M Narco Tire-Cut Filler

Combines in one the efficiency of the best cement, cut filler and mastic. A thoroughly high-grade self-vulcanizer.



Ask Any Regular User

When you hear a fellow-motorist ask for a J-M (Mezger) Soot-Proof Spark Plug, ask HIM why he specifies "J-M (Mezger) Soot-Proof." His answer is always ready—an enthusiastic tribute to the quality, service and satisfactory performance of this plug.



J-M (Mezger) Soot-Proof SPARK PLUG

This plug actually insures more power and greater economy of fuel because it delivers at all times the biggest, fattest, hottest spark the current can create and because it does not leak under compression.

The J-M (Mezger) Plug remains soot-and-leak-proof, and the porcelain insulator has been tempered to a degree that makes it heat-proof.

The J-M (Mezger) Soot-Proof Plug is easily disassembled because it is built in two units.

Look for "J-M" on porcelain. Price, 75 cents. Write for booklet.

H·W·JOHNS - MANVILLE CO·

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Washington
Wilkes-Barre
Youngstown

THE CANADIAN H. W. JOHNS-MANVILLE CO., LIMITED

Toronto Montreal Winnipeg Vancouver

3245

Please mention The Automobile when writing to Advertisers

—even this old boy
is hitting on
all cylinders

**BUT—
He's Wasting Fuel**

Don't make this mistake—don't be deceived—don't think that because your engine is hitting on all cylinders you're getting maximum service.

Write us now for wonderful revelations in gas economy—let us show you something you've probably never before thought of—let us tell you of a certain positive way to get more miles per gallon than you're getting now, whether your car is new or old.

This astonishing new information will not obligate you. We're showing thousands of car owners how the New Stromberg Carburetor gives more mileage—more speed—more power, economy, flexibility and acceleration. A postal will do—state make of car and model. This is of vital importance to you—be sure to write today.



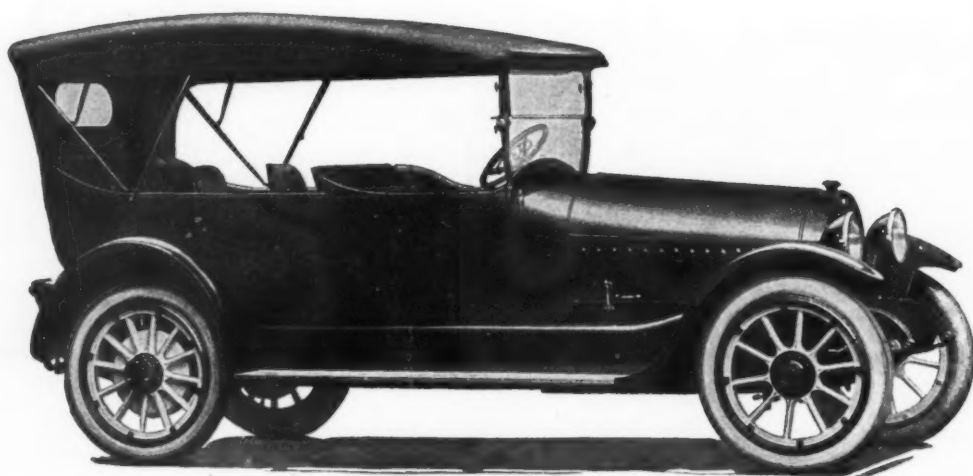
New STROMBERG Saves it!

Stromberg Motor Devices Company, 64 E. 25th St., Chicago

Please mention The Automobile when writing to Advertisers

THE EASIEST-RIDING CAR IN THE WORLD

A New Series Marmon "Forty-One"



Superlative of Body Refinement

THE new series Marmon "Forty-One" is chiefly remarkable because of an extraordinary development in body design and construction. The finest of automobile chassis is now fitted with bodies which, like the mechanism, leave nothing to be desired. The beautiful sheet aluminum touring car bodies

are lighter in weight—stronger, roomier and better in finish and details—giving greater comfort and more pleasing lines. The greatest forward step in the upholsterer's art is shown in the new straight pipe upholstery which gives a new and added luxury to these distinctive new designs.

The new series Marmon "Forty-One" is furnished in Five and Seven-Passenger Touring Cars—the "Club" Three-Passenger Roadster and Two-Passenger Speedster Bodies—the most beautiful and distinctive bodies America has ever produced

Nordyke & Marmon Company

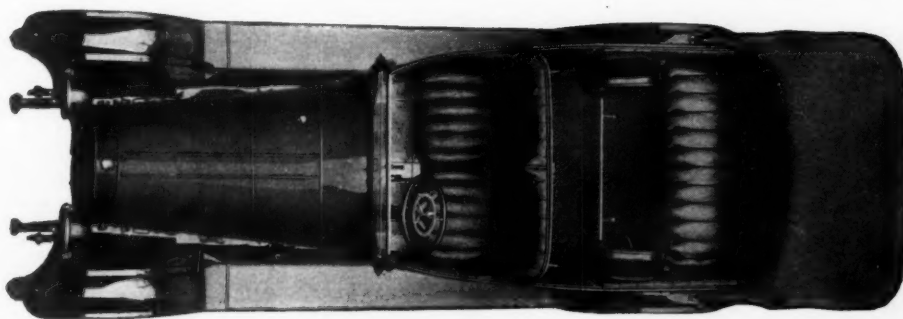
Indianapolis (Established 1851) Indiana

OVER SIXTY YEARS OF SUCCESSFUL MANUFACTURING

Please mention The Automobile when writing to Advertisers

THE EASIEST-RIDING CAR IN THE WORLD

A New Series Marmon "Forty-One"



No Change in Chassis

THERE is not a material change in the chassis of the new series Marmon "Forty-One."

The proven six-cylinder Marmon engine—the famous Marmon oiling system with the specially designed enclosed cam shaft—the wonderful Marmon clutch—spiral bevel drive—Bosch electrical system—and many other details, combine to make the "41" chassis

the highest example of mechanical excellence. We could not improve them.

The result is a car that excels in acceleration—hill-climbing—speed—endurance—every point convincingly proven by the actual performance of stock cars during the past season.

The price is unchanged.

The value is backed by our standing offer—"Make us prove it!"

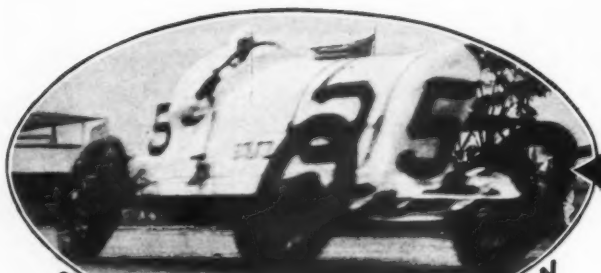
Dealers who appreciate that real value, not attractive promises, sells automobiles—who know the profits of dealing with the big man of the community—will get the details of this Marmon proposition. How about proving it to you?

Nordyke & Marmon Company

Indianapolis (Established 1851) Indiana

OVER SIXTY YEARS OF SUCCESSFUL MANUFACTURING

Champions



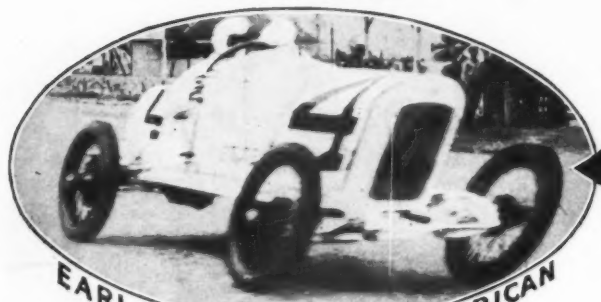
GIL ANDERSON, STUTZ AMERICAN
SPEED CHAMPION

SPEED

Wisconsin

CONSISTENT

Champion American Speedway Motor. First American car to finish at Indianapolis, Gil Anderson in Stutz — holder of American miles per hour record, 500 miles in 5 hours, 42 minutes, 28 seconds; average, 87.6 miles per hour. Earl Cooper, Stutz, second American car to finish, average, 86.19 miles per hour. Wilcox, Stutz, average, 79.66 miles per hour.



EARL COOPER, STUTZ AMERICAN
ROAD RACE CHAMPION

CONSISTENCY

Wisconsin

CONSISTENT

Champion American Road Race Motor. Wisconsin Motors have won for the Stutz more road races in the last four years than any other car has won in the last ten years.



BARNEY OLDFIELD, STUTZ, LOS ANGELES-
PHOENIX DESERT RACE

ENDURANCE

Wisconsin

CONSISTENT

Champion Desert Race Motor. Barney Oldfield, Stutz, Los Angeles-Phoenix desert race, 696 miles in 23 hours. Champion American Coast-to-Coast Motor. E. G. Baker, in Stutz Bearcat, holder of transcontinental record, San Diego, Calif. to New York City, 3,728.4 miles, 11 days, 7 hours, 15 min., clipping 4 days, 2 hours, 45 min., from former record.



E. G. BAKER, STUTZ BEARCAT,
TRANSCONTINENTAL RECORD

ECONOMY

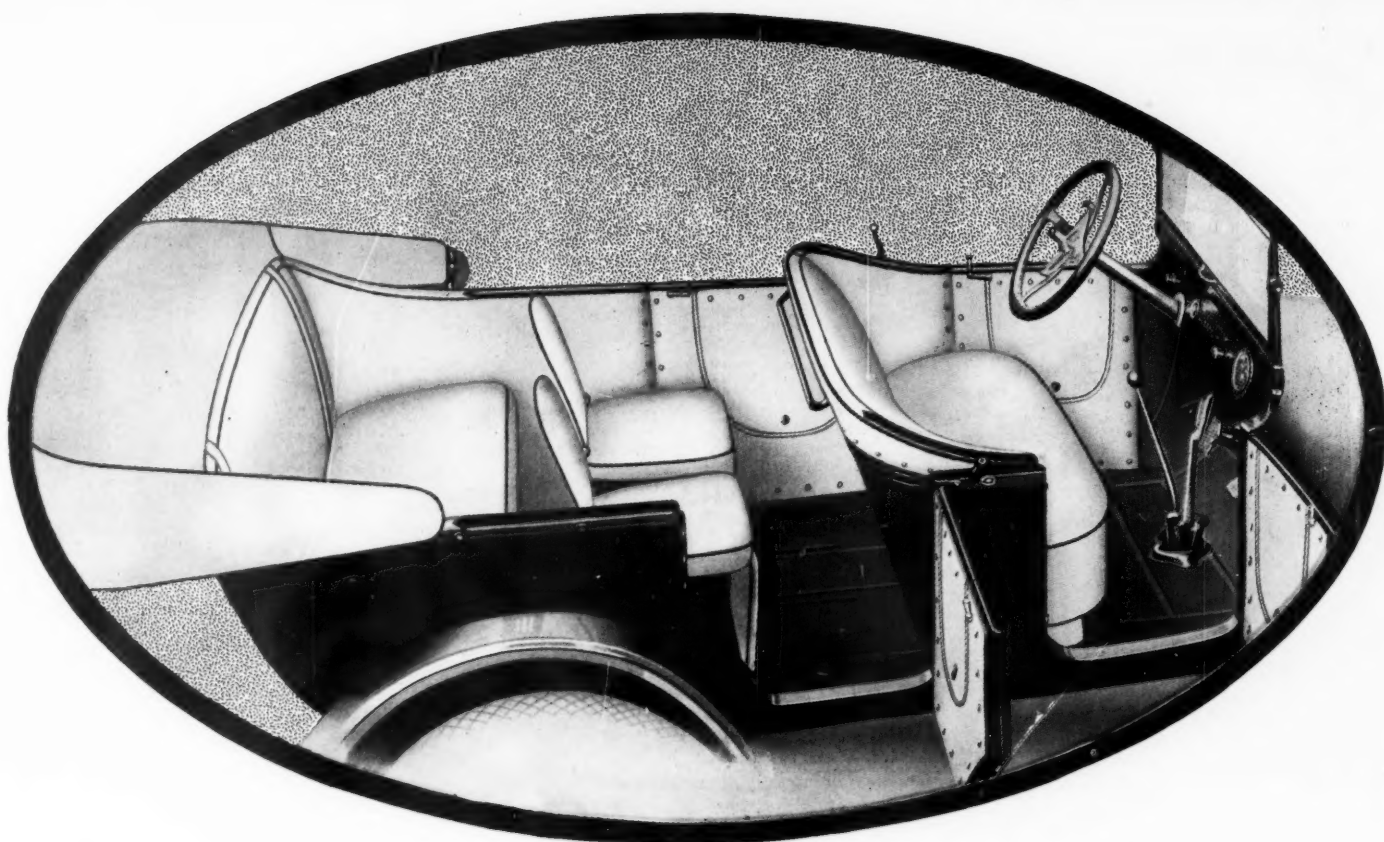
Wisconsin

CONSISTENT

Mr. Baker used 352 gallons of gasoline on transcontinental trip, averaging 10.6 miles per gallon. Motor $4\frac{3}{4} \times 5\frac{1}{2}$. Used $8\frac{1}{2}$ gallons oil, or 440 miles per gallon. Official A. C. A. test after run showed an average fuel consumption 0.65 lb. per B. H. P.

WISCONSIN MOTOR MFG. CO.
STA. A. DEPT. 310 MILWAUKEE, WIS.

Please mention The Automobile when writing to Advertisers



Give your car this luxurious look



Write for this catalog

Every dealer, every car owner should get a copy of our new catalog, describing and illustrating many other accessories, all sold under the Campbell guarantee. We have an especially attractive proposition for progressive dealers.

With every efficient mechanical accessory included as regular equipment on the car, the eyes of the automobile world are turned toward greater luxury.

Luxury—with all the added beauty, comfort and pride of ownership that go with it—is the aim of every motorist.

Campbell Detachable Upholstery gives you this luxury in a way no other single accessory can. It transforms the interior of your car into a drawingroom. It is the last word in refinement.

Campbell Detachable Upholstery goes on over your regular upholstery, and is held in place by special snap fastenings, so that it can be instantly removed for cleaning.

It can be obtained for all standard makes and models of cars in a wide range of fabrics and shades at surprisingly moderate prices. Every set is custom tailored to a permanent glove-fit. Its durability is greater than that of cheap leather coverings. See that you get it on your new car or, better still, put it on your old car and make it look like new.

Write today for samples and prices

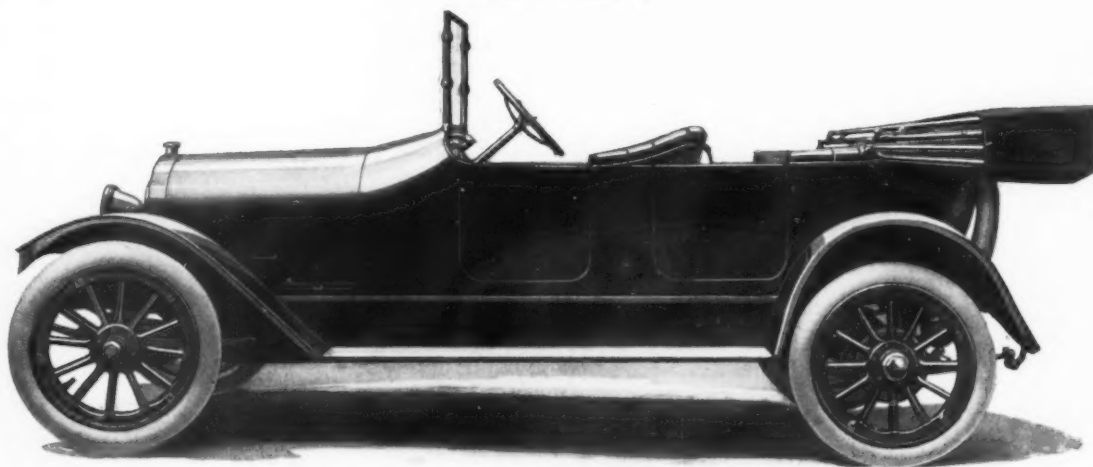
of Campbell Detachable Upholstery. Whether you are a manufacturer, a dealer or an owner, you owe it to yourself to investigate this accessory. Write today to

The Perkins Campbell Co.
633 Broadway, Cincinnati, O.
New York Office, 89 Chambers St.



The name Campbell on the fastenings guarantees the genuineness of Campbell Detachable Upholstery. Look for it.

CAMPBELL GUARANTEED MOTOR CAR ACCESSORIES



New Model CE-30

More Car—Lighter Weight—Greater Power

The 1916 CROW ELK-HART contains all the high-grade features of our previous thirty-five horsepower model—our famous E-45 which sold for \$1150. But the price is \$425 less. It has the same style streamline body, the same high-grade blue-black finish, more horsepower per pound with efficient long five-inch stroke motor—but **this car weighs 650 pounds less.** Increased production and greater factory efficiency make this wonderful motor-car value possible.

In detail finish, mechanical fineness, comforts and conveniences this 1916 CROW ELK-HART gives you **ALL** there was in our highest-priced models—**And it sells for but \$725, completely equipped.**

SPECIFICATIONS:

Wheelbase, 112 inches.	Left-Hand Drive; Center Control.
Motor, 3½"x5".	Built-In Double Ventilating Rain-Vision Windshield.
FULL Floating Rear Axle.	Instrument Board on Cowl Dash.
Improved Multiple Disc Clutch.	Thermo-Syphon Cooling.
Full 5-passenger Body.	Headlight Dimmers.
Latest Streamline Design.	Stewart Speedometer.
Oval-Shaped Radiator.	32" Wheels—Demountable Rims.
Underslung Three-Quarter Elliptic Springs on Rear.	Disco Starter and Lighting System.

And Note the Weight—1950 Pounds

The Triumph of our Seven Years in Motor-Car Building!
Get our Proposition Quick!

Dealers!

Don't judge this car by its price. Investigate for yourself. Write or wire **NOW** for our proposition.

More than 200 dealers are selling the CROW ELK-HART.

With this car you can get your share of the 1916 business.

CROW MOTOR CAR CO. 1500 NO. MAIN ST. **Elkhart, Ind.**

